Gesture in Karnatak Music: Pedagogy and Musical Structure in South India

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GESTURE IN KARNATAK MUSIC: PEDAGOGY AND MUSICAL STRUCTURE IN SOUTH INDIA

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ABSTRACT

This thesis presents an examination of gesture in Karnatak music, the art music of South India. The topic is approached from two perspectives; the first considers Karnatak music structure from a gestural perspective, looking both at the music itself and at the gestures that create it, while the second enquires into the role played by physical gesture in vocal pedagogy. The broader aims of the thesis are to provide insight into the musical structure of the Karnatak style, and to contribute to wider discourses on connections between music and movement. An interdisciplinary approach to the research is taken, drawing on theories and methods from the fields of ethnomusicology, embodied music cognition, and gesture studies.

The first part of the thesis opens with a discussion of differences between practical and theoretical conceptions of the Karnatak style. I argue for the significance in practice of *svara-gamaka* units and longer motifs formed of chains of such units, and also consider the gestural qualities of certain motifs and their contribution to *bhāva* (mood). Subsequently, I present a joint musical and motoric analysis of a section of Karnatak violin performance, seeking to elucidate the dynamic processes that form the style. The second part of the thesis enquires into the role played by hand gestures produced by teachers and students in vocal lessons, looking at what is indexed by the gestures and how such indexing contributes to the pedagogic process. This part of the thesis also considers how gestures contribute to the formation and maintenance of common ground between teacher and student. The final chapter brings the two strands of this thesis together to discuss the connections that exist between musical and physical gesture in Karnatak music.

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NOTES ON TRANSCRIPTION AND TRANSLITERATION

In this thesis, musical phrases are transcribed into both Indian *sargam* notation and Western staff notation. *Sargam* notation is a system of solmisation wherein the seven *svaras* in an octave (*ṣaḍja*, *ṛṣabha*, *gāndhāra*, *madhyama, pañcama, dhaivata,* and *niṣāda*) are referred to by their initial syllables: *sa*, *ri*, *ga*, *ma*, *pa*, *dha*, and *ni.* In this thesis, I have used the full *svara* names when referring to individual *svaras*, and the *sargam* syllables when denoting phrases, and also in transcriptions.

Ṣaḍja may be placed at whichever pitch the performer prefers; however, there are conventions for each instrument that tend to be followed. While the scholarly norm for transcribing Indian music to Western staff notation is to place *ṣaḍja* at C (262 Hz), I have chosen to transcribe the material in this thesis with *ṣaḍja* at A (440 Hz). The reason for this choice is that the transcriptions in this thesis are all of violin performance and by transcribing to A, I bring Western and Indian violin fingering into alignment. In India, the string Western violinists think of as the A string is tuned to *ṣaḍja* at whichever pitch the soloist is performing. By bringing the fingerings into alignment I aim to make it easier for Western violinists to understand the hand motion and fingering occurring in the phrases. This is important due to the fact that the gestures used to create sound are a major topic of this thesis.

Technical terms used in Karnatak music are largely drawn from the Sanskrit lexicon, and have been transliterated here with appropriate diacritics using standard scholarly conventions as found, for example, in Powers and Widdess (2001) and Pesch (2009). All non-English terms have been rendered in italics, with the exception of *rāga* names, caste names, musical styles, and titles of musical treatises. The English plural form of non-English technical terms has been used throughout.

Media Files referred to in this thesis can be found in the accompanying DVD. In addition, Media Files in chapter 3 can be viewed via the URLs provided.

PREVIOUSLY PUBLISHED MATERIAL

Sections from chapters 2 and 3 of this thesis have been published in the following article:
Pearson, L. (2016). Coarticulation and Gesture: An Analysis of Melodic Movement in South Indian Raga Performance. *Music Analysis*. doi: 10.1111/musa.12071

DECLARATION

Chapter 3 in this thesis includes some material submitted for my Master of Arts examination at Goldsmiths College, University of London in September 2012, which contains an analysis of the same extract of *rāga* Toḍi and an initial discussion of coarticulation in the style. However, chapter 3 of this thesis includes a substantial amount of new material derived from research made while at Durham University after starting my PhD studies. The new research involved the video-tracking of the violinist's hand motion and subsequent visualisation of this data, leading to new insights that have been presented in the analysis here. Other new elements in chapter 3 of this thesis include the substantial revision of the analysis and arguments originally presented, improved transcriptions into Western staff notation, and a discussion of atomistic and gestural conceptions of the style held by musicians. As this considerable amount of new material could not be used without the previously examined material I have sought and received permission from Durham University to include this in my thesis.

STATEMENT OF COPYRIGHT

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This thesis owes much to the inspiration and guidance of my Karnatak violin teacher T.V. Ramanujacharlu. It was his profound knowledge and artistry that inspired me to undertake research on Karnatak music, and he showed endless patience and generosity in responding to my questions and allowing me to video his lessons and demonstrations. In addition, I am enormously grateful to all of the other Karnatak music teachers and students, who despite their busy schedules contributed their time and carefully considered thoughts to my research. In particular I would like to thank the following musicians for allowing me to video their lessons and conduct interviews with them: T.S. Sathyavathi, Suguna Varadachari, T.V. Ramprasadh, Mysore Nagaraj, Mysore Manjunath, G.J.R. Krishnan, Vittal Ramamurthy, Mudikondan Ramesh, Kasi Visalakshi, Koviladi Kala, Uday Kiran, Hamsini Nagendra, Sukanya Prabhakar, H.K. Narasimha Murthy, P. Rajagopal, and their students Ashwini Satish, Sevia Sethuraman, S. Hiranmayee, Brindha Manickavasakan, Aishwarya Shankar, Kiran R. Pai, Shruthi Ranjani, Harish Narayan, E.P. Malyatha, Meghana Satish, Rekha Ravishankar, Ranjani Badrinath, T.H. Yashaswee, G. Raghava, Anjana P. Rao, K. Lavanya, Ravishankar Rajagopalan, S.R. Ravikiran and Madhuri Kaushik. Thanks also to the following musicians for granting interviews and providing other assistance: Akkarai Subhalakshmi, Trichy B. Harikumar, Ganesh Rajagopalan, Lalgudi Vijayalakshmi, A. K. Kousalya, Pattabhiram Pandit, Hemmige S. Prashanth, Charulatha Ramanujam, H.S. Sundhindra, Balu Raghuraman, Subathra Raghuraman, Pantula Rama, M.S.N. Murthy, R. Visweswaran, Sriranga Ramapriya, Radhika Balakrishnan, S.V. Sahana, and L. Archana.

At Goldsmiths, University of London I was lucky to be taught by Barley Norton who first introduced me to work on embodied music cognition and learning to perform as a research technique. His excellent teaching, and also his help and encouragement during my MA studies were crucial factors in my progress on to PhD research. In addition, I am grateful to John Baily for his pioneering contributions on music and movement, and for his interest in my work.

This thesis cannot be imagined without the theoretical foundations laid by Rolf Inge Godøy. Not only is his work an essential guiding force behind this thesis, but he has also been an ally: always approachable and willing to discuss issues relating to my research. I would like, in particular, to thank both Rolf Inge Godøy and Alexander Refsum Jensenius for supporting my visit to the University of Oslo in October 2014 to learn motion-capture techniques. During my stay there I met Kristian Nymoen and Mari Romarheim Haugen who both helped enormously by contributing much of the code that developed into the Matlab

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1 Introduction and Literature Review

1.1 Research questions

This thesis presents an examination of gesture in Karnatak music,[1] a genre of South Indian art and devotional music. The aims of this thesis are to provide insight into the musical structure of the style, and to contribute knowledge on the connections that exist between physical gesture and music in this context. Three types of gesture are considered here: the sound-producing gestures made by musicians, the musical gestures (motifs and phrases) that arise as a result, and the sound-accompanying hand gestures spontaneously produced by vocalists. By examining these three types of gestures rather than focussing on just one, I aim to facilitate a broader reflection on the connections that lie between them.

The main body of the thesis is comprised of two parts. The first part (chapters 2 and 3) considers Karnatak musical structure from a gestural perspective, looking both at the music itself and the physical movements that create it. Here, the following question is asked:

- What insight can an examination of musical gestures (motifs and phrases) and musicians' sound-producing gestures provide into the structure of Karnatak music and the dynamic processes that engender the style?

This part of the thesis includes a discussion of theoretical and practical conceptions of Karnatak music, followed by a joint musical and motoric analysis of a section of violin performance that seeks to elucidate the dynamic processes that generate the style.

The second part of the thesis (chapters 4 to 8) enquires into the role played by physical gestures in the pedagogic process, asking the following questions:

- What musical qualities and features are indexed by teachers' hand gestures?
- How does such indexing contribute to the student's learning process?

These two questions are explored using a variety of analytical approaches, including thematic analysis of interviews with musicians, empirical analysis of correspondence between musical pitch and hand position, qualitative analysis of mapping between gesture and musical qualities, and analysis of the role played by gesture in the creation of common ground

[1] The full Sanskrit name of the style is *Karnāṭaka Saṅgīta* (Pesch 2009). While many scholarly texts refer to this genre as Karnatak music ('Karnatic' and 'Karnatik' can also be seen found), in India and elsewhere the name is more popularly transliterated as 'Carnatic'.

between teacher and student. In the concluding chapter of the thesis, I consider various gesture production theories in light of the evidence presented here and discuss the connection between musical and physical gesture in the Karnatak style.

The study of gesture in music necessarily requires consideration of the wider relationships between music and movement, and the ways in which music conveys motion. In this thesis, I view the sense of movement as a primary expressive element in music, a position that has been held in common by an otherwise diverse range of commentators, including music critics, musicologists, and philosophers of music (for example Hanslick 1957; Shove and Repp 1995; Scruton 1997; Godøy 2003). This introductory chapter will, therefore, include a discussion of literature relevant to musical motion as well as musical gesture. Before describing the research background of this thesis in detail, I will first give a brief introduction to the musical context in which my enquiry is situated.

1.2 Musical context

The musical antecedents of the contemporary Karnatak style were performed in the royal courts and temples of South India, but as the courts suffered losses of power and wealth during the 19th century a gradual shift in patronage took place (Subramanian, L. 2006, 2008a, 2008b). The primary patrons of Karnatak musicians today are local cultural organisations known as *sabhās* and government-run institutions such as All India Radio (Viswanathan and Allen 2003, pp. 86–88). Karnatak music is mainly popular amongst the Brahmin communities of South India and their diaspora around the world, although interest and involvement in the style extends beyond this caste to some extent (Viswanathan and Allen 2003).[2] A thriving concert scene can be found in many South Indian cities, particularly in Chennai, a city closely associated with Karnatak music since the beginning of the 20th century (Subramanian, L. 2006), and it is common for Brahmin children to learn to either sing or play an instrument in the Karnatak style, especially if they come from a family with musical lineage. It is this contemporary practice of Karnatak music in South India that will be examined in this thesis, although there will also be some consideration of writings in historical treatises, as elements from the theories contained therein colour contemporary thought on the style.

The research here arose, in part, from several years that I spent in South India learning to perform Karnatak violin. In the course of my training, I realised that there is a strong gestural component to the style, by which I mean that certain characteristic motifs

[2] A notable exception to Brahmin dominance in the Karnatak style is that of Periya Mēḷam musicians employed by temples to perform at Hindu rituals who are from the Isai Vēḷāḷar caste (Terada 2008). There is evidence to suggest that the performance of Karnatak music historically was more diverse in its caste composition than it is at present (Peterson and Soneji 2008, p.10; Pranesh 2003).

require the reproduction of specific gestural qualities both in the hand movements used to play the violin and in the sound produced. At the same time, I observed that vocal teachers commonly produce hand gestures while demonstrating phrases to their students, as well as while performing in concerts. The hand motions were clearly connected to the music being sung; however, the nature of this connection was not obvious as the gestures are spontaneous rather than part of a formal system and have no codified meaning. Over time, my observations on sound-producing and sound-accompanying gestures led to the formation of the questions investigated in this thesis, which although somewhat diverse are connected through their focus on gesture in music. By looking at the same theme from different angles and using different modes of analysis, I aim to shed light on the Karnatak style and also to reflect on broader questions of music and gesture both within and beyond this particular musical context.

1.3 Theoretical background and methods

In order to answer the research questions posed, an interdisciplinary approach is taken here, working across the fields of ethnomusicology, embodied music cognition, and gesture studies. Theories and hypotheses that have influenced this research include those proposing that music cognition is founded on bodily sensorimotor experience, and on accumulated embodied interaction with the environment (Godøy 2003, 2010; Clarke 2001, 2005; Windsor and de Bézenac 2012; Reybrouck 2005a, 2014; Krueger 2014). Thus, I take an embodied and situated approach to the study of gesture in Karnatak music, drawing primarily on work with an ecological and enactive perspective. From the field of gesture studies, I refer to studies demonstrating that gestures help us think (Alibali et al. 2000; Chu and Kita 2016) and learn (Alibali et al. 2013; Goldin-Meadow and Wagner 2005), while from ethnomusicology I draw on work suggesting that the analysis of physical gestures in musical contexts can provide insight into music structure (Baily 1977, 1985) and music cognition (Clayton 2007; Fatone et al. 2011). Methods employed in this thesis are also drawn from across the three disciplines. From ethnomusicology, I use methods such as semi-structured interview, participant observation, and learning to perform as a research technique; from the field of embodied music cognition, I apply an empirical approach to the analysis of movement and sound; and from gesture studies, I undertake systematic video coding for the analysis of gesture and interaction.

Much of the literature relating to particular research questions will be discussed within the main body of the thesis; for example, literature on Karnatak music is discussed in chapters 2 and 3. However, a survey and discussion of relevant literature in the wider fields of embodied cognition and ecological psychology is presented in this introduction in order to

provide a foundation for what will follow. In addition, this chapter includes a discussion of literature on musical motion, music and gesture, and learning to perform as a research technique, before closing with an overview of the chapters contained within the thesis.

1.4 Embodied music cognition and perception-action coupling

This thesis is situated within the field of embodied music cognition, in which it is argued that our accumulated physical interaction with the world plays a significant role in the way we experience and think about music (Leman 2007; Godøy and Leman 2010; Reybrouck 2005b). In particular, I draw on research proposing that the physical movements that arise in the creation of, and in response to music are integral to musical experience and part of musical meaning (Shove and Repp 1995; Clarke 2001; Godøy 2003; Reybrouck 2005b: Cox 2011). Such research has various antecedents including work in areas such as conceptual metaphor theory, embodied cognition, ecological psychology, and perception-action coupling. Some of the major theoretical strands within these areas will be outlined here, followed by a discussion of their influence on the field of embodied music cognition.

1.4.1 Conceptual metaphor

The theory of conceptual metaphor, presented by Lakoff and Johnson (1980) proposes that metaphors are not merely verbal constructions used for rhetorical effect, but instead that our entire conceptual system is fundamentally metaphorical in nature (1980, p. 3). In their seminal publication, *Metaphors we live by*, Lakoff and Johnson explained that metaphor is founded on 'experiential grounding', which has a physical basis arising from our accumulated interaction with the world (1980, pp. 17-20). For example, metaphors such as 'He's in *top* shape' and 'He came *down* with the flu', demonstrate metaphoric thinking in which health and life are up or high, while sickness and death are down or low. In this case, the 'experiential grounding' and physical basis is that serious illness and death forces us to lie down (1980, p. 15; emphases in the original).

In their later work, both authors placed more emphasis on the embodied aspect of conceptual metaphor theory. Lakoff and Johnson (1999) develops the idea that at the basis of conceptual metaphors lie 'primary metaphors', characterised as cross-domain mappings between the sensorimotor domain and the domain of subjective experience (1999, p. 58). Cross-domain mappings, a subject that will be discussed at length in chapters 6 and 7 of this thesis, are perceptual correspondences between different sensory and physical domains; for example, between vertical height and musical pitch, or between object size and loudness. Such mappings arise, in part, from our tendency to internalise correlations found in our

embodied interactions with the environment (Spence 2011, p. 988). Lakoff and Johnson occasionally use the term cross-domain mapping synonymously with conceptual metaphor, as in the following extract from Johnson (2007):

> Concepts that we think of as utterly divorced from physical things and sensorimotor experiences (concepts such as justice, mind, knowledge, truth, and democracy) are never really independent of our embodiment, because the semantic and inferential nature of these abstract concepts is drawn from our sensorimotor interactions, typically by cross-domain mappings (conceptual metaphors). (2007, p. 273)

Thus, for Lakoff and Johnson, conceptual metaphor, which is based on physical experience of the world, underpins our conceptual system. Therefore, our conceptual system is fundamentally embodied and situated. As a result, their combined work is an important precursor and contribution to the contemporary field of embodied cognition, influencing research in diverse fields including philosophy, psychology, musicology, education, and gesture studies.

1.4.2 Embodied cognition

In the influential publication *The Embodied Mind* (Varela et al. 1991), the term 'embodied' is used to highlight two points:

> [F]irst, that cognition depends upon the kinds of experience that come from having a body with various sensorimotor capacities, and second, that these individual sensorimotor capacities are themselves embedded in a more encompassing biological, psychological, and cultural context. (1991, pp. 172-173)

In this description, we find the two elements that typically define the field of embodied cognition: that cognition is *embodied* (dependent on the nature and experiences of the body), and also *situated* (embedded in the wider biological, psychological and cultural context). The terms *embodied* and *situated cognition* necessarily overlap (the wider context must include the body), although embodied cognition places more emphasis on what Anderson (2003) calls the 'physical grounding project': the detailing of the ways in which cognition is grounded in 'the physical characteristics, inherited abilities, practical activity, and environment of thinking agents' (Anderson 2003, p. 126).

Varela et al. (1991) draws heavily on the work of Maurice Merleau-Ponty (1908-1961) (in particular from Merleau-Ponty 1942/1965 and 1945/1962), describing the relationship between cognition, the body, and the environment as circular in nature:

> We reflect on a world that is not made, but found, and yet it is also our structure that enables us to reflect upon this world. Thus in reflection we find ourselves in a circle: we are in a world that seems to be there before reflection begins, but that world is not separate from us. (Varela et al. 1991, p. 3)

In this way, our perceptions and reflections on this world are viewed as inseparable from the structure and sensorimotor experiences of the body, as well as the world in which we find ourselves. Within Varela et al. (1991) there lies a critique of cognitivism and its recourse to representational theories of cognition, in which 'the mind is thought to operate by manipulating symbols that represent features of the world' (p. 8). In opposition to such representational views, Varela et al. (1991) define their approach as 'enactive', emphasising that cognition should be considered not as 'problem solving on the basis of representations', but rather as the 'enactment or bringing forth of a world' based on connections made through our accumulated experience of being in the world (p. 205). For Varela et al. (1991) representational theories break the interrelationship between cognition, the body and the environment, leading the world to be viewed as pre-given rather than brought forth through cognition (1991, p. 135).

The issue of whether cognition involves representations is one of the key disputed points in the field of embodied cognition. Gallagher (2011a) notes that the various accounts within the field differ greatly in the extent of their opposition to representational and classical computational models of cognition, and that, in addition, there is no consensus on the weight that should be given to the concept of embodiment. As we have seen, the work of Varela et al. (1991) is fundamentally anti-representational. Alongside these, Gallagher (2011a) characterises the work of Alva Noë, Daniel Hutto, and himself as being examples of 'radical (enactive) embodiment' (pp. 67-68), in which representational accounts and classical computational models of cognition are rejected. Gallagher argues, however, that a significant proportion of publications in the field include representational elements in their accounts, including Clark (2008) and Rowlands (2010), which take an approach described by Gallagher (2011a) as 'embodied functionalism' (p. 64). As we shall see later in this chapter, similar differences and disagreements can be found within the field of embodied music cognition.

1.4.3 Early influences on the field of embodied cognition

In the course of their account of the embodied mind, Varela et al. (1991) argue that 'sensory and motor processes, perception and action, are fundamentally inseparable in lived cognition' (p. 173). This statement epitomises an approach that can be traced back at least as far as William James (1842-1910) who proposed that 'Every representation of a movement awakens in some degree the actual movement which is its object' (James 1890/1981, p. 1134). James (1890/1981) presented what has subsequently been termed an 'ideo-motor' view of perception and action (Greenwald 1970; Prinz 1987), in which the idea of an action initiates the execution of that that action unless there is some inhibiting factor (1890/1981, p. 1133). Although this theory fell quickly out of favour at the time, aspects of this approach have been revived in recent work on action and perception (Prinz 1987; Hommel 2009), which will be discussed later in this chapter.

The notion that perception and action are intertwined can also be seen in the work of another pragmatist philosopher, John Dewey (1859 – 1952), who in 1896 presented a critique of the reflex arc concept: a view of perception current at that time. The reflex arc concept proposed that perception and action proceeded in three distinct stages; receiving a stimulus, registering it with attention, and then reacting with action (1896, p. 361). Dewey contended instead that the first stage is action:

> Upon analysis, we find that we begin not with a sensory stimulus, but with a sensori-motor coordination, the optical-ocular, and that in a certain sense it is the movement which is primary, and the sensation which is secondary, the movement of body, head and eye muscles determining the quality of what is experienced. In other words, the real beginning is with the act of seeing; it is looking, and not a sensation of light. (1896, p. 358)

Similarly, Dewey argued later in the article that hearing a sound is also an action: 'the sound is not a mere stimulus, or mere sensation; it again is an act, that of hearing' (1896, p. 362). Thus Dewey claimed that perception is active, and it is action that initiates a perception.

Moreover, Dewey's approach to perception and cognition was fundamentally situated. He consistently argued against views suggesting that the perception of an object could be considered in isolation from the wider context of that event, stating that 'In actual experience, there is never any such isolated singular object or event; *an* object or event is always a special part, phase, or aspect, of an environing experienced world – a situation' (Dewey 1938/1960, p. 67). Due to his situated stance and views on perception as action,

Dewey's work has been a strong influence on work within the field of embodied cognition, particularly on that of Johnson (2007, 2015).

Emerging from a quite different philosophical tradition, that of phenomenology, the work of Maurice Merleau-Ponty (1908-1961) has also greatly influenced current theories of embodied cognition. His view of perception as dependent on the perceiver's accumulated experiences and the demands of the present situation, is apparent in the following description of a soccer player's perception of the field:

> For the player in action the soccer field is not an 'object' […] It is pervaded with lines of force (the 'yard lines'; those which demarcate the 'penalty area') and is articulated into sectors (for example, the 'openings' between the adversaries), which call for a certain mode of action. The field itself is not given to him, but present as the immanent term of his practical intentions; […] Each manoeuvre undertaken by the player modifies the character of the field and establishes new lines of force in which the action in turn unfolds and is accomplished, again altering the phenomenal field. (1942/1965, pp. 168-169)

In this way, Merleau-Ponty proposes that our perception of the world is situated and dependent on our opportunities and intentions for action, a view that, as we have seen, is emphasised in Varela et al. (1991).

A related, but certainly not identical, view of perception can be found in Gibson's (1979) concept of affordances, in which it is proposed that the world appears to us as opportunities for action rather than as an assemblage of objective perceptual qualities and forms. He explains affordances thus: 'The *affordances* of the environment are what it *offers* the animal, what it *provides* or *furnishes*, either for good or ill' (1979, p. 127). Gibson notes that the affordances offered are dependent on our physical qualities and accumulated experience; for example, an animal's perception of a surface is dependent on the type of support it offers the animal, which is dependent on the nature of the animal itself: water appears to people as 'sink-into-able', while for water bugs this is not the case (1979, p. 127). Gibson describes such affordances as existing throughout the environment and in all types of human interaction:

> The different substances of the environment have different affordances for nutrition and for manufacture. The different objects of the environment had different affordances for manipulation. The other animals afford, above all, a rich and complex set of interactions, sexual, predatory, nurturing, fighting, playing, cooperating, and communicating. […] We play the closest attention to the optical and acoustic

> information that specifies what the other person is, invites, threatens, and does. (Gibson 1979, p. 128)

By extension, an allied proposal for the perception of sound and hence of music would be that rather than perceiving a sound we perceive the affordances of the sound. The field of ecological psychology, which emerged in part from Gibson's work, has since contributed research towards an ecological theory of sound perception. Notably, Gaver (1993b) proposed that 'Everyday listening is the experience of hearing events in the world rather than sounds per se' (p. 285). Empirical work in this field has found that listeners tend to define sounds by the cause of the event rather than its sound qualities (Vanderveer 1979), and that listeners can reliably discriminate between breaking and bouncing sounds even when only temporal properties of the sound are retained (Warren and Verbrugge 1984). Such work suggests that we are highly sensitive to the cause of a sound, which informs us of what the sound 'is, invites, threatens, and does', as predicted in ecological theories of perception (Gibson 1979, p. 128).

Ecological approaches to sound perception have also been applied to music (for example, Windsor 1995, 2000, 2011; Windsor and de Bézenac 2012; Clarke 2001, 2005; Reybrouck 2012, 2014), and a discussion of such work will be presented later in this chapter.

1.4.4 Common coding and mirror neurons

Building in part on some of the theories discussed above, a great deal of research in the fields of cognitive neuroscience and psychology has focussed on seeking to understand the mechanism behind the connections between action and perception. Drawing on James' (1890/1981) 'ideomotor' theory, in which the idea of an action is considered linked to its execution, Prinz (1987, 1997) developed a framework termed the 'common-coding approach' in which 'perceived events and planned actions share a common representational domain' (p. 129). An allied approach can be found in Hommel's (1997) action-concept model, which proposes that cognition is based on action-effect codes, used for perception as well as for action control (1997, p. 281). The implication of such work for perception is that 'observing, imagining, or in anyway representing an action excites the motor program used to execute that same action' (Kilner et al. 2007, p. 159). The evidence presented by Prinz (1997) and Hommel (1998) in support their claims is drawn largely from psychological experiments, for example employing interference paradigms, which are based on the idea that a code that is busy with perception cannot at the same time be functional in action planning and action control.

Other methods used to examine commonalities between action and perception include neuroimaging techniques such as functional magnetic resonance imaging (fMRI) and magnetoencephalography (MEG). Studies employing such techniques to examine action and perception in dancers and musicians have found that the networks of motor areas involved in preparation and execution of action are also involved in observation of actions in those performers skilled in the movements observed (Calvo-Merino et al. 2005; Bangert et al. 2006). The so-called 'mirror neuron system' is often proposed as being implicated in such findings. Mirror neurons are a class of neurons that have been found to be active both when an action is performed and when an action is observed (Rizzolatti et al. 1996; Gallese et al. 1996). The same researchers that discovered mirror neurons in monkeys suggested that such neurons were also present in humans, presenting evidence of similarities in motor evoked potentials between subjects observing an action and subjects performing the same action (Rizzolatti et al. 1996). The discoveries produced a huge amount of interest both within and beyond the field of cognitive neuroscience, and the mirror neuron system has subsequently been used to explain connections between action and perception in a wide range of arenas including language, action understanding, empathy, learning, and the performance and reception of various art forms.

While the existence of neurons that are active both when performing an action and when observing the same action is largely not in doubt, their origin and explanatory power is contested (Hickok 2009; Heyes 2010; Catmur 2013; Gallagher 2007). Hickok (2009) argues against the idea that mirror neurons are the basis of action understanding as presented, for example, by Gallese et al. (1996) and Rizzolatti and Craighero (2004), advancing physiological and neuropsychological evidence against the notion (Hickok 2009). Hickok, whose primary area of research is neuroanatomy of language, also critiques the idea that the existence of mirror neurons provides support for motor theories of speech perception, as claimed, for example, in Gallese et al. (1996). Motor theories of speech perception propose that the objects of speech perception are not the sounds produced, but rather the intended phonetic gestures of the speaker, represented in the brain as invariant motor commands (see Liberman and Mattingly 1985). Findings presented by Hickok against the motor theory of speech perception include evidence that damage to the motor speech areas does not necessarily impede speech recognition (2009, p. 14). He concedes that sensory-motor circuits may contribute to speech recognition, but argues that this is not the primary mode through which speech is understood (2009, p. 15; see also Hickok et al. 2011).

Another alternative to dominant accounts of the mirror neuron system has been presented by Heyes (2010), who contests the idea that mirror neurons are an evolutionary adaptation for action understanding, proposing instead that they are a by-product of associative learning (2010, p. 575). In support of her claims, Heyes (2010) cites evidence that

mirror neurons play a contributory but not dominant role in action understanding (Mahon 2008), and data showing that the mirror neuron system in adults can be transformed by sensorimotor learning. These include studies showing that the mirror neuron system in musicians and dancers is modulated by experience, with increased mirror activation in rehearsed pieces compared to pieces unknown to the performer (D'Ausilio et al. 2006; Cross et al. 2006). Heyes (2010) therefore suggests that the qualities observed in mirror neurons are formed through accumulated experience of observing and executing similar actions.

This associative learning account of mirror neurons has found wide support (Cook, R. et al. 2014; Catmur 2013), and a conceptually similar model has been presented by Keysers and Perrett (2004). Such work differs from evolutionary adaptation accounts of the mirror neuron system by shifting the balance of explanatory power away from mirror neurons themselves to the environments in which they develop, an approach that calls for more research looking at when and how mirror neurons evolve (Cook, R. et al. 2014, p. 46).

1.4.5 Interim summary

It can be seen from the review presented here that although evidence suggests that action and perception are connected at the neuronal level, the origins and implications of such connections are contested. In addition, while there is strong support for the idea that cognition is embodied there is no agreement on the extent or nature of this embodiment. This lack of consensus is mirrored in the field of embodied music cognition, which is heavily influenced by the approaches discussed above.

While some work in the field of embodied music cognition draws on a combination of the theories and evidence discussed up to this point (for example, Leman 2007; Godøy 2003), other research employs particular approaches. Windsor and de Bézenac (2012), Clarke (2001, 2005), and Reybrouck (2001, 2014), for example, draw primarily on Gibson's (1979) theory of affordances and other ecological approaches to perception. Windsor and de Bézenac (2012) take a position that is particularly close to Gibson's theory of affordances, emphasising a relational approach (in which properties emerge from the relationship between an object and an organism) that does not involve mental representations (2012, p. 107). Reybrouck (2001, 2014) also draws on the concept of affordances, and proposes an enactive form of embodied music cognition that largely eschews strong forms of representation. Such approaches are rare in the field of embodied music cognition, with most accounts involving representational elements in their models. An example of such work can be seen in Maes et al. (2014b), which draws on the common coding approach of Prinz (1997) and Hommel et al. (2001) wherein cognitive representations are central. However, representational approaches to cognition have been critiqued on the basis that they implicitly support both the duality of

body and mind, and the divide between the mind and the world 'outside' (see Johnson 2007 pp. 113-134; Varela et al. 1991; Wilson and Golonka 2013; and in the context of music cognition, Matyja and Schiavio 2013; Windsor and de Bézenac 2012).

Notwithstanding the lack of consensus in the field of embodied music cognition regarding the extent and nature of embodiment and the model of cognition proposed, the research achieved to date in the field allows for a discussion of possible causes for the observed connections between music and motion, which will be the subject of the next section in this thesis.

1.5 Musical motion

As the concept of musical motion, the sense of motion conveyed through music, is particularly important to a consideration of the relationship between music and gesture, it will be discussed here at some length. The concept has a long history, with a diverse array of music critics, musicologists, and philosophers of music proposing that the sense of motion conveyed through music is one of the primary expressive elements in the art form (Hanslick 1957; Scruton 1997; Truslit 1938). For example, Hanslick (1957) stated that 'the essence of music is sound and motion', while Scruton (1997) claimed that if the movement in music is not heard, then music itself is not experienced:

> For suppose someone said that, for him, there *is* no up and down in music, no movement, no soaring, rising, falling, no running or walking from place to place. Could we really think that he experienced music as we do, that it was, indeed, *music* for him, rather than some other art predicated upon the interest in sounds? Surely, the temptation is to say that we *must* hear the movement in music, if we are to hear it as music. (Scruton 1997, p. 52)

Observing musical practices across cultures, it is clear that motion is connected with making and listening to music. Listening to music engenders motion. This is most obviously seen in dance music, but even at concerts of styles not currently associated with dancing, such as, for example, Karnatak, Hindustani, and free jazz, hand, foot, and head motion is often seen amongst audience members. Another indication of the connection between music and motion can be seen in the common use of motion related words to describe music; a melody might 'soar' or 'plummet', a rhythm can 'pulsate', and a phrase may have an 'undulating' quality. The use of these motion words to refer to music seems entirely natural, and most people will have an understanding of the types of musical phrase that such words could be used to describe.

Another connection between music and motion can be seen in the way that hand movements are used by conductors to convey musical qualities: not only musical metre, but also subtle qualities of emphasis, shape, and musical motion (Bräm and Boyes Braem 2001). Therefore, it is clear that music can engender, express, and convey motion, and, in turn, motion can convey analogous musical qualities. But why do we experience motion when listening to music, and what form of motion is conveyed? Here, I will survey the primary accounts of musical motion, many of which draw on theories discussed above, before presenting the model of musical motion that will be used in this thesis.

1.5.1 Musical motion as metaphor

The idea that musical motion is purely metaphorical is epitomised by Scruton (1997) who despite claiming 'Whenever we hear music, we hear movement' (p. 55), proposes that such movement is purely metaphorical. His idea of metaphor, furthermore, is not one founded on embodied experience and cross-domain mappings as found in Lakoff and Johnson's (1980) conceptual metaphors. This is because, musical experience for Scruton is essentially 'acousmatic': devoid of any reference to the physical world (1997, p. 19). For Scruton, it is the metaphor of musical motion itself, rather than physical motion, that is the intentional object of music:

> [T]here lies, in our most basic apprehension of music, a complex system of metaphor, which is the true description of no material fact, not even a fact about sounds, judged as secondary objects. The metaphor cannot be eliminated from the description of music, because it defines the intentional object of the musical experience. Take the metaphor away, and you cease to describe the experience of music. (1997, p. 96)

But as we have seen, Lakoff and Johnson (1980) convincingly explain that metaphors have their bases in the physical world, and are founded on cross-domain mappings formed through accumulated embodied experience. Therefore, even if musical motion were conceived of as metaphoric, such metaphors would be founded on prior embodied interactions with the world that in turn may also colour the present experience of the listener (for the latter point see Driver and Spence 2000; Vroomen and De Gelder 2004). In fact, Mark Johnson influenced and later collaborated with Steve Larson on a theory in which experiences of musical motion are proposed to arise from metaphorical associations with forces (including 'gravity', 'magnetism', and 'inertia') that are formed through embodied experience (Larson 2002; Johnson and Larson 2003).

Beyond this initial argument against Scruton's position, there are, in addition, very good reasons for believing that musical motion is not metaphorical but instead, perceptually real. Empirical studies looking at physical movements produced by subjects in response to music have found positive correlations between the motions produced by different people in response to the same musical phrase (Küssner et al. 2014; Caramiaux et al. 2010; Burger et al. 2010). Similarly but in reverse, studies have found that vocal sounds with similar sonic features are made by people in response to the same hand motions (Erdemir et al. 2012; Erdemir et al. 2015). In addition, in a study by Leman et al. (2009) wherein listeners were requested to move a stick in response to a *guqin* performance without seeing the musician, correlation was found between the velocity profiles of the performer and listeners. Such results suggest that connections between movement and music are not random, but rather are constrained to an extent by mappings between the two. Considering the connections observed between music and movement, and the consistency across movements evoked by a particular musical phrase, it seems likely that motion conveyed by music is perceptually real rather than metaphorical.

Moreover, there are a number of theories accounting for musical motion as being perceptually real. Clarke (2001) argues this point convincingly drawing on evidence from the field of ecological psychology which demonstrates that when we hear sounds we perceive their causes (Vanderveer 1979; Warren and Verbrugge 1984) and suggesting that the same occurs when we listen to music. This and other accounts of musical motion as perceptually real rather than purely metaphorical will be considered in the remainder of this section. Here, I explore two types of perceptually real motion proposed by musicologists, that which is experienced as real but created through a musical fiction, and that which arises from the actual movements of musicians.

1.5.2 Motion created through musical fiction

In his ecological account of auditory perception, Gaver (1993a, 1993b) proposed that the primary perceptual object in listening is the cause of sounds rather than sounds themselves. Although Gaver excluded musical listening from his ecological account (1993a), other researchers have viewed musical listening as subject to the same environmental clues as everyday listening. Windsor (1995, 2000, 2011), Clarke (2001, 2005), Windsor and de Bézenac (2012), Reybrouck (2012, 2014) and Krueger (2014) have all produced ecological accounts of musical listening. Clarke (2001) in particular engages with the question of how an ecological perspective can account for experiences of musical motion, and so I will focus on this article here.

Clarke (2001) argues that 'since sounds in the everyday world specify (among other things) the motional characteristics of their sources, it is inevitable that musical sounds will also specify movements and gestures' (p. 222). He proposes that two types of motion may be accounted for through an ecological approach. The first is related directly to the physical movements of musicians produced in order to play the music (which I will discuss in the next section), while the second is created through a kind of musical fiction, in which the composer or performer fashions an auditory environment that implies the motion of a virtual sound source. The way in which such virtual movement is created will be outlined in this section.

Clarke's (2001) account of 'the way in which musical sounds may specify the objects and events of a *virtual* environment' (p. 217) draws on the work of Bregman (1994), the creator of the 'auditory scene analysis' model of auditory perception. According to this model, we make sense of our sonic environment by perceiving 'auditory streams' of information. These are sequences of sound that are perceived as likely to emerge from a particular source or event; for example, a sequence of footsteps, or the sound of a fire burning (1994, pp. 9-10). Bregman proposes that this model of auditory perception is also applicable, and indeed necessary, for musical listening, allowing us to perceive the voice of a soprano and the sound of a piano occurring simultaneously, as two separate auditory streams (pp. 10). Further to this proposal, Bregman suggests that the auditory streams we perceive in music can, as a result of changes in loudness or timbre, be experienced as emerging from a particular source that is moving in relation to the listener. In the following extract, he describes how such experiences depend on the perception of auditory streams:

> Transformations in loudness, timbre, and other acoustic properties may allow the listener to conclude that the maker of a sound is drawing nearer, becoming weaker or more aggressive, or changing in other ways. However, in order to justify such conclusions, it must be known that the sounds that bear these acoustic relations to one another are derived from the same source. [...] This strategy of allowing discrete elements to be the bearers of form or 'transformation' only if they are in the same stream is the foundation of our experience of sequential form in music as much as in real life. (1994, p. 469).

The model described here by Bregman, in which changes in loudness and timbre can convey the movement of a fictional sound source, draws on McAdams' (1984) concept of a 'virtual source': the illusion created through orchestration that the sound of several instruments played simultaneously is emerging from one source or event. Clarke (2001) elaborates on the work of Bregman and McAdams by discussing particular musical examples of this type of virtual sound source that appears to be moving in relation to the listener. The first of these

examples includes a dramatic orchestral crescendo on a single pitch in Alban Berg's opera, Wozzeck, in which gradual change in timbre and dynamics conveys the impression of a 'highly focused and unswerving approach' (2001, p. 223). Clarke also provides an example involving timbral change, describing a section from the track "Build it up, Tear it down" by the artist Fatboy Slim in which a bass instrument sound is initially heard as if through a low pass filter and then evolves as though the cut-off frequency of the filter is gradually being raised, leaving a much brighter and clearer sound. Clarke describes the motion effect that this creates as a 'continuous movement towards a sound source which is at first occluded, but which progressively reveals itself', an effect that draws on principles of ecological listening in which 'a sound source that is occluded in relation to a listener (behind an object, or below a horizon) will contain fewer high frequency components than the acoustic array from an unoccluded source' (2001, p. 225).

An earlier ecological account of musical experience by Windsor (1995) also draws on work by Bregman (1994) and McAdams (1984) to make similar points to those presented by Clarke (2001), although focussing more on the context of electroacoustic, acousmatic music. In addition, some of the same themes have been developed in Windsor and de Bézenac (2012). Other ecological accounts of musical listening have focussed more on affordances such as entrainment to rhythm (Krueger 2014; Reybrouck 2014) and opportunities for action offered in the relationship between the musician's body and the body of the instrument (Reybrouck 2014). These more recent accounts, however, do not consider Bregman's (1994) proposal that changes in loudness and timbre can specify the movement of a virtual source, and thus lack Clarke (2001) and Windsor's (1995) perspective on the significance of virtual sound sources in musical listening. However, entrainment is likely to be significant in experiences of musical motion, and so a discussion of this phenomenon is presented in section 1.5.4.

In summary, ecological accounts of musical motion such as those presented by Clarke (2001) and Windsor (1995) explain the way in which music conveys perceptually real movement through a type of musical fiction, in which changes in loudness and timbre give the impression of a moving virtual sound source. Depending on the way it is presented, a crescendo may appear to the listener as an approaching virtual sound source, while a diminuendo may be perceived as the opposite. Musical phrases often start with increases in loudness and end with a diminuendo, and so in this way a phrase may appear as a movement towards and away from the listener. Similarly, an oscillating pitch movement performed with a change in timbre on each oscillation may mimic the acoustic properties of an object rotating in space in relation to a static listener, and, therefore, may be experienced thus. Through such examples it can be appreciated that many of our experiences of musical motion are the result

of fictional motion effects created through sound in line with ecological principles of listening.

1.5.3 Motion arising from the gestures of the performer

The second type of perceptually real motion considered in this thesis is that which arises from the actions that create musical sounds: the physical gestures of musicians. Ecological accounts propose that when listening to music we perceive the body motion of musicians due to the ecological principle that sounds specify their sources (Clarke 2001). In a similar vein, Shove and Repp (1995) suggest that we perceive the gestures that create music through the patterns of emphasis heard therein:

> No one needs to see how high the feet are being raised to hear someone walking or to sense the continuity of the leg movements between the discrete footsteps. The series of footsteps is a natural, lawful consequence of the continuous movements of the legs (indeed, of the whole body). In this respect, their timing and amplitude 'specify' the continuity of movement. The same, we submit, is true of performance movement: the timing and amplitude of the sound-producing attacks lawfully specify the movement spanning a group of attacks, which one can hear as a unit of motion – as a gesture. (1995, p. 60)

Windsor (2011) makes a similar point, proposing that listeners perceive the gestures that lie behind musical features such as acceleration, deceleration, pauses and agogic accents due to the ecological principle that we perceive sound not only for itself, but also as a source of information about what is creating that sound (p. 55).

Beyond the primarily ecological accounts already discussed in the previous section on fictional movement, there are, in addition, many other musicologists who propose that listeners experience something of musicians' sound-producing actions. Godøy (2003, 2010, 2011) draws on both ecological accounts and motor theories of perception to propose a 'motor-mimetic' element in music perception in which 'we mentally imitate sound-producing actions when we listen attentively to music' (2003, p. 318). Cox (2001, 2011) defines a related 'mimetic hypothesis' in which we understand music through 'tacit imitation', or 'mimetic participation' based on our prior embodied experience of sound production (2001, p. 195). This mimetic participation is described as 'a kind of physical empathy that involves imagining making the sounds we are listening to' (2011). Cox suggests that mirror neurons may be involved in this process, but notes that their existence in humans is still open to doubt,

and that, in addition, they may only be indirectly relevant to his mimetic hypothesis (2011, p. 3).

The mirror neuron system plays a far more central role in the Shared Affective Motion Experience (SAME) model created by Overy and Molnar-Szakacs (2009) (see also Molnar-Szakacs and Overy 2006) to account for experiences of motion and emotion in music. Drawing primarily on the predictive coding account of the mirror neuron system (Kilner et al. 2007), Overy and Molnar-Szakacs (2009) propose that mirror neurons play an important role in a mechanism that leads music to be perceived 'not only as an auditory signal, but also as intentional, hierarchically organised sequences of expressive motor acts behind the signal', with the result that 'expressive dynamics of heard sound gestures can be interpreted in terms of the expressive dynamics of personal vocal and physical gestures' (2009, p. 492). The usefulness of accounts of musical motion in which the mirror neuron system is central to the models proposed will clearly depend on the progress of research on mirror neurons and the outcome of on-going debates regarding their origin and explanatory power (Hickok 2009; Heyes 2010). There is evidence from the field of neuroscience that connections between action and perception are formed as a result of musical practice (Lahav et al. 2007; D'Ausilio et al. 2006; Margulis et al. 2009). From this, it could follow that musicians perceive a higher degree of musical motion arising from sound producing gestures than non-musicians, or musicians who play a different instrument or style of music. However, at this stage the way in which such evidence from neuroimaging studies relates to individual listeners' experience of music is unclear.

In conclusion, while connections between action and perception at the level of the brain appear to be implicated in listeners' experiences of movement arising from musicians' sound-producing gestures, there is, as yet, no consensus within the field on how to interpret such evidence. However, even in the absence of established brain-based models to explain experiences of musical motion, I argue that ecological accounts of musical listening, such as those provided by Clarke (2001, 2005), Windsor (1995, 2011), and Shove and Repp (1995), already provide a good explanation for the tendency of listeners to perceive, and therefore experience, the actions and motions that create music.

1.5.4 Entrainment to pulse and rhythm

In addition to the two types of perceptually real experiences of musical motion discussed above, entrainment to pulse should also be considered. Entrainment can be defined as a phenomenon in which two or more independent rhythmic or oscillatory processes synchronise with each other (Clayton et al. 2005; Krueger 2014). This can occur in objects (two pendulums connected by a common surface), animals (fireflies illuminating in synchrony)

and humans (dancing to music) (Clayton et al. 2005; Krueger 2014). In a music listening scenario where the music is recorded rather than live, the entrainment is in one direction only; although, as Krueger notes, it may be argued this is not a one-way process as our experience of the music shifts as we respond to it (2014, p. 3, footnote 7). In his ecological account of musical experience, Krueger (2014) suggests that music affords not only movement but also entrainment, a process he describes as 'bodily gearing onto musical structures'. While entrainment is clearly an important part of musical experience related to motion, I would view it as a process following from experience of the two types of perceptually real musical motion already discussed here. Therefore, while acknowledging that entrainment can occur even when listening to the type of unmetred music discussed in this thesis, it will not be considered further in this thesis.

1.5.5 Types of motion considered in this thesis

In summary, two types of perceptually real motion experiences in listeners will be considered in this thesis: that arising from the perceived movement of virtual sound sources, and that arising from musicians' sound-producing gestures. These can be defined as follows:

- **Virtual motion**. This arises from the perception of virtual moving sound sources, the illusion of which is created through musical features such as changes in loudness, timbre, and pitch, which due to ecological principles create the impression of sound emanating form a moving source.

- **Actual motion of musicians' sound-producing gestures**. Such motion is experienced due to the tendency for listeners to perceive something of the actions and motions that create sound.

In addition to these two types of perceptually real musical motion, there are other experiences of motion arising during music listening that will not be discussed in this thesis, such as entrainment to a pulse.

The two types of perceptually real musical motion discussed here have at their basis our accumulated embodied experience of the relationship between physical movement and sound. Such accumulated experience has been proposed as one of the causes of cross-domain mappings found between various sensory modalities; for example, that between musical pitch and vertical height (Spence 2011, p. 987; Eitan and Granot 2006). Perception in general has been shown to be multimodal; cross-domain mappings occur across a wide range of modalities (Spence 2011), and cross-modal interactions between sound, vision, and sense of

motion are found in both musical and non-musical contexts (Driver and Spence 2000; Sams et al. 1991; Schutz and Kubovy 2009). Therefore, it should be of no surprise that music invokes experiences of motion through a variety of means. Research on cross-domain mapping and sensory integration will be discussed further in chapters 6 and 7 of this thesis.

1.6 Gesture in ethnomusicology and musicology

The gestures examined in this thesis may be divided into three types: the physical gestures that create musical sounds, the musical gestures (motifs and phrases) that arise as a result, and the physical gestures that accompany sound-production but that may appear to be ancillary. These three types of gesture are referred to here respectively as sound-producing gestures, musical gestures, and sound-accompanying gestures. It should be noted that the distinction between sound-producing and sound-accompanying gestures is, in many cases, unclear: gestures that appear to be non-essential to the production of musical sound may in fact significantly contribute towards the performance and be 'essential' from the performer's perspective (Montague 2012, p. 4; Godøy 2010 p. 111; Cook, N. 2013 p. 316). When asked to perform without 'nonessential' movements, musicians find it difficult to play in a 'normal' or 'expressive' manner (Thompson and Luck 2012, p. 35). However, the distinction between sound-producing and sound-accompanying gestures is one that is commonly noted both in academic literature and in popular culture; for example, musicians have often been ridiculed by music critics and cartoonists for their gesturing habits.[3] The distinction may be useful, therefore, if only to highlight that gestures which initially appear as ancillary to an observer may in fact be essential for that performer, and also substantially contribute to the musical experience of an audience member or co-performer.

All three of these gesture types, sound-producing, musical, and sound-accompanying, are connected to experiences of musical motion. As discussed above, one type of musical motion arises directly from sound-producing gestures. Furthermore, virtual motion is also created through sound-producing gestures, as sound-producing gestures are of course required for the creation of musical features such as change in loudness, timbre, and pitch. Other connections between gesture and musical motion also exist. As we shall see later in this thesis, sound-accompanying gestures frequently convey qualities of musical motion, and musical gestures (motifs and phrases) can be defined through their expression of bodily motion. There has been considerable literature published on all three types of music related

[3] An example of such ridicule can be found in Göschl's well known cartoon from 1873 of Liszt in contorted positions while playing piano (as cited in Jensenius 2008, p. xiv).

gesture, much of which is discussed in the body of this thesis. In addition, an overview and discussion of the relevant literature will be presented in the section that follows.

1.6.1 Musical gestures

This section will examine the concept of 'musical gesture', that is to say the use of the word gesture to refer to a segment of musical performance, such as a motif or phrase. The questions of why musical motifs and phrases are commonly described as 'gestures' and in what sense they might properly be described as such have been explored in semiotic and analytical work by authors including Coker (1972), Lidov (1987, 1999, 2006), Cumming (2000) and Hatten (2004, 2006). Lidov (1987) defines gestures as 'brief, expressive molar units of motor activity, be they of the limbs, the larynx, the torso, etcetera, units which are whole but not readily subdivisible' (1987, p. 77). His account of musical gestures focuses on their expressive aspect, drawing on work by Clynes (1976) who hypothesised the existence of fundamental 'sentic forms', defined by Lidov (2006) as brief energy shapes, which constitute part of the neurological apparatus of emotion that can be realised through patterns of neuromuscular activation or by patterns of sound (2006, p. 29). Lidov proposes, therefore, that we should define both musical and physical gesture as 'a class of schemata for brief effort patterns linked with primary emotions' (2006, p. 42).

While Lidov sees a clear connection between body motion (muscle activation) and the concept of musical gesture, Cumming (2000), on the other hand, queries the extent to which musical gestures can be mapped to human movement. In argument against a simple mapping between the two, she proposes that 'hearing certain kinds of melodic movement as "gestural" can be recognised as a propensity that extends well beyond cases in which any likeness to human movement can be realistically claimed' (p. 163). Cumming suggests instead that the term gesture is also used in musical contexts to refer to phrases that suggest an 'agent' even in the absence of implied physical movement (p. 164).

The approach taken by Hatten (2004, 2006) circumvents negotiating questions regarding the relationship between musical gestures and bodily movement by defining gesture through qualities that underlie both physical and musical gesture. His definition of gesture as 'any energetic shaping through time that may be interpreted as significant' (2006, p. 1) has much in common with that of Lidov (2006), who similarly refers to 'energy shapes' that underlie both physical and musical gestures. However, Lidov's (2006) approach refers more strongly back to a physical basis, drawing, as we have seen, on Clyne's (1976) 'sentic forms' of neuromuscular activation. Hatten (2006), in contrast, places more emphasis on the fundamentally intermodal nature of gesture: 'a gesture may be created or interpreted in any

medium or channel, and it may entail any *sensory perception, motor action or their combination*' (p. 1).

The second part of Hatten's definition states that the energetic shaping should be interpreted as 'significant': it should be considered meaningful by an interpreter (2006, p. 1). Therefore, even without direct communicative intent, a gesture may still be considered as such as long as it is found to be meaningful. Similarly, the definition of gesture presented by Coker (1972) also involves a response from the listener, but the response in this case goes beyond an interpretation of the gesture as meaningful. Coker's approach to both gesture and musical gesture is distinct from others discussed here in its emphasis on the interaction between gesturer and addressee. In order to formulate his interactive account of gesture, Coker (1972) draws on the work of George Herbert Mead (1863-1931) who viewed gesture as part of a conversation in which gestures are attitudes or movements that call forth a response in another (Mead 1934, p. 14). Mead viewed gesture and language as intimately related, with language being a form of symbolic vocal gesture (1934, p. 61). Therefore, his definition of gesture as an attitude that calls forth a response in another is applied to both language and body gesture.[4] Coker (1972) extends from this and applies Mead's definition to musical gesture, stating, 'Thus, as the object "music" calls out dispositions and responses in us, we properly speak of the gestural meaning of music' (1972, p. 15).

I would suggest that this definition of musical gestures is apt, as it identifies significant elements that underlie both musical and physical gestures, namely the presentation of an attitude that calls for a response. The performance of music only makes sense as an attempt to affect either another person or the self, and so the word gestures is, therefore, suitably applied to musical phrases. The definition presented by Mead (1934) and extended by Coker (1972) is valuable because it works for all types of gesture while also successfully limiting the field of what may be termed a gesture; for example, an utterance, body movement, or musical phrase may not be referred to as a gesture if it fails to call forth a response. In this way, identifying a phrase as a 'musical gesture' does not rely on it having a particular form, similarity to human movement, or sense of agency (as in Lidov 1999 and Cumming 2010), but requires only that it evokes a response in another.

Mead (1934) further proposed that 'the function of gesture is to make adjustment possible among the individuals implicated in any given social act with reference to the object or objects with which that act is concerned' (p. 46). Coker draws on this idea in his account of musical gesture, proposing that musical motives, phrases, themes and sections may all be taken as gestures conveying attitudes that act as stimuli which prompt the listener's

[4] Mead defines attitudes as 'beginnings of acts' (1934, p. 5): that which occurs within a person that leads to an action of some sort.

adjustment of his or her own attitude (1972, p. 20). He elaborates on this conversation of gestural attitudes in music listening as follows:

> The listener tends to respond impulsively and involuntarily, liking or disliking what he hears, feeling tendencies and their fulfilments or frustration. However, in contrasting, self-conscious responses, the listener chooses his own attitude and heeds the attitudes and changes of attitude shown by the gestures of the music. He savors the feeling tone of each gesture. He thinks about the attitude the musical gesture reveals or seems to conceal. And, too, the listener stays aware of his own disposition, noting the attitudes the music's gestures tend to draw from him. (p. 21)

Considering that Mead's formulation is of a 'conversation of gestures' it might be wondered where the mutual response lies in the case of pre-composed music: how does music adjust to the listener in response to his or her attitude? Coker's answer is that the music is composed in a manner that anticipates the attitude of the listener at each moment, and provides a response based on this anticipation (p. 21).

Coker's (1972) account stands out amongst the work on music and gesture for its extensive elaboration on the interactive mechanism of musical gesture. While some work in the wider field of musicology does acknowledge the social and interactive nature of gesture (for example, Leman 2010), much of the research in this area defines musical gestures by virtue of their connection with the sound-producing movements of musicians. For example, Windsor (2011) observes that the 'gestures' that might be discovered in a score by a music analyst or performer are linked to the movements made by musicians (p. 45). While I agree that musical gestures can be defined based on their connections to the body motions that create the music, I would argue that there is much to be gained by also understanding musical gestures, like physical gestures, as tools of social interaction that enable people to adjust with respect to each other.

Finally, I suggest that these two definitions of musical gesture - that based on mapping with body gestures and that based on presentation of an attitude that calls forth a response in another – are interrelated. A gesture defined as an attitude that calls forth a response also has its basis in the body movement that created it: the attitude must be realised in some way. This is the case for musical gesture and all types of physical gesture, including Mead's (1934) verbal gestures (language). It is even the case for architectural gestures, which require human motion through the action of drawing at certain stages of the architectural process. Hence, there is no conflict between defining musical gestures as attitudes that call forth the response of another, and the acknowledgment that such musical gestures are also intimately connected to the physical gestures that create them.

Therefore, in this thesis I will consider musical and physical gestures as both emergent from bodily gestures and functioning as 'part of the organization of the social act' (Mead 1934, p. 44). The importance of this latter approach will become more apparent in the chapters discussing gestural interaction between teacher and student in lessons (in particular, chapter 8). However, it is also significant when considering music alone, as the essence of music is interaction between performer and listener, with the performer producing phrases that aim to call forth a response either from another person, or from the self. Mead (1934) and Coker's (1972) approach to physical and musical gestures respectively prevent us viewing them as simply 'expressive' or 'symbolic', but rather demonstrate that although gestures may refer back to the motions that form them or emotions connected to them, their function is to enable interaction and adjustment.

1.6.2 Sound-producing and sound-accompanying gestures

While in the previous section I discussed the use of the word gesture to refer to musical phrases and motifs, here I will focus on research examining the physical gestures made by musicians. Research in this area has flourished in the last thirty years with the emergence of performative and embodied paradigms within academia. Several edited volumes have been published specifically on music and gesture (Godøy and Leman 2010; Gritten and King 2006, 2011) in addition to a wealth of articles and book chapters. Some of the work on music and physical gesture has already been discussed in the section above on musical motion (1.5), including literature proposing that we experience something of performers' sound-producing gestures when we listen to music (Shove and Repp 1995; Cox 2011; Godøy 2003). The work of Rolf Inge Godøy (2003, 2006, 2010, 2011) has been particularly influential on this thesis for its conception of music as comprised of 'gestural-sonic objects': short chunks of music, typically a couple of seconds long, in which individual notes are subsumed under the wider gestural motion that produces them (2011). Godøy's research will be discussed further in chapters 2 and 3 of this thesis. Here I will consider other relevant work on sound-producing and sound-accompanying gestures.

First it is worth considering why musicians' physical movements might be referred to as gestures rather than simply as movements. One approach is to define movement as gesture on the basis that it intends or evokes meaning (for example, Jensenius et al. 2010, p. 13). However, definitions of gesture that involve notions of meaning or significance also raise many questions; in what sense is the proposed gesture meaningful and does the meaning need to be intended by the performer, understood by the listener, or both? Leman and Godøy (2010) note that the a gesture considered meaningful by one person may not be viewed as such by another, and suggest that the subjective nature of meaning may be the reason that the

majority of researchers define gesture based on its physical qualities (p. 5). In comparison to definitions of gesture based on meaning or significance, the definition provided by Mead (1934) and Coker (1972), an attitude or movement that calls forth a response in another, leaves fewer unanswered questions. Here both the attitude and response may be either unconscious or intended. Furthermore, the question of meaning does not arise, as the definition rests on calling forth a response from the listener, rather than an attribution of meaning. The definition provided by Mead and Coker allows for the subjective and context dependent nature of gesture, and is, therefore, particularly apt. If a concertgoer or musicologist responds to a musician's physical movements, the movement has evidently called forth a response in that context, and is, therefore, not merely a movement but a gesture.

Some of the earliest research on music and gesture arose from the field of ethnomusicology, due, as Baily (1985) noted, to the predisposition for the discipline to study music making as a process, rather than music as a product (1985, p. 238). Baily identified a tendency within Western musicology to disregard the role played by the body in musical experience and structure (1985, p. 238), a position with which he disagreed. In response, he produced studies examining the sound-producing movements of performers (Baily 1977; Baily and Driver 1992). Baily considered that there were two important questions to be answered relating to music and the body: how musical patterns are represented cognitively by the performer as patterns of movement rather than simply as patterns of sound; and the extent to which musical structure is shaped by sensorimotor factors (1985, p. 237). Another example of body-focused analysis from the same period can be found in Yung's (1984) discussion of the significance of kinaesthetic and visual elements in the performance of the Chinese seven-string zither.

There has since been a gradual accumulation of research exploring the types of questions asked by Baily (1985). Several studies have considered the relationship between sound-producing gestures and musical structure; Bungert (2015) reflects on compositional decisions in a Corrente by J. S. Bach through an analysis of the performer's physical actions; Montague (2012) explores the structural role played by physical expansion in sound-producing gestures in a Chopin Étude; Fisher and Lochhead (2002) present analyses of performer gesture and kinaesthetic experience in Joan Tower's Fantasy, and a Brahms clarinet sonata; and Henbing and Leman (2007) formulate a gesture-based typology of guqin music. In addition, there have been many studies of sound-producing gestures in pursuance of research questions unrelated to musical structure. For example, Wiesendanger et al. (2006) look at coordination between bowing and fingering in violinists, Schoonderwaldt and Demoucron, (2009) examine violin bowing motion, and Goebl and Palmer (2013) analyse the relationship between timing precision and hand movement efficiency in pianists.

Other authors have taken a phenomenological approach to the analysis of the musician's body in performance. Sudnow (1978) contributed a monograph describing the process through which he learnt to perform jazz on the piano from a phenomenological perspective, often focussing on his experience of his own hands. More recently work by Doğantan-Dack (2011, 2015) on gesture and touch in piano performance and Järviö (2006, 2010) on the singing body have provided valuable performer accounts of physical experience in musical performance. These phenomenological accounts demonstrate the extent to which, for the performer, music may be conceived as motion of the body, and also show that creativity can be the play of such motion, topics that will be discussed further in chapter 2.

In addition to these various approaches to the study of sound-producing gestures, research has also been conducted on sound-accompanying gestures in musical styles from a wide range of cultures. Some of this work examines the impact of performers' sound-accompanying body movement on audience experience. In Davidson (1993) a visual presentation of performers' body movements shown without sound was found to more clearly communicate the type of expression intended than a presentation of the sound alone, while a more recent study by Vuoskoski et al. (2014) demonstrated that the effect of visual kinematic cues on perception of overall expressivity is stronger than that of auditory cues (p. 591). Research looking at the relationship between performer body movement and musical structure has found that the visual component of performance carries much the same structural information as the audio component, and that gestures can elongate the sense of phrasing during a pause in the sound (Vines et al. 2004, p. 468). Sound-accompanying gestures have also been found to affect the perception of particular musical features; the length of gestures used by marimba players biases audience perception of the length of the notes produced (Schutz and Lipscomb 2007; Schutz and Kubovy 2009), and visual kinematic cues affect ratings of loudness variability (Vuoskoski et al. 2016). Furthermore, pitch discrimination has been found to be significantly biased by spatial movement in hand gestures accompanying singing, with downward gestures making pitches seem lower than they really are, and upward gestures making them appear higher (Connell et al. 2013). Based on these findings, Connell et al. (2013) conclude that the mental representation of pitch and space is shared and audio-spatial in nature (p. 124). Such studies reveal the significant influence of performers' body movements on audience members' experience of musical features, structure, and expressivity.

There have been a few studies in which musicians' gestures are analysed with respect to gestural typologies adapted from the field of research on co-speech gestures. Davidson (2001) draws on Ekman and Friesen's (1969) typology to define gesture types in a performance by Annie Lennox, while Clayton (2005, 2007) adapts a scheme originally created by Rimé and Schiaratura (1991) for his analysis of gestural and musical interaction in

the performance of North Indian music (gestural typologies are discussed further in chapter 4). Other work focussing on sound-accompanying gestures has discussed the role of hand gesture in music transmission (Rahaim 2012; Fatone 2010; Gillan 2013), analogies of motion expressed through music and gesture (Leante 2009; Fatone et al. 2011), and the insight provided by audience gesture into their perception of musical structure (Clayton 2007). Thus it can be seen that the analysis of sound-accompanying gesture can provide insight into expressivity, communication, and the perception of music. Some of the work mentioned here will be discussed further in chapters 4 to 8 of this thesis, which focus on sound-accompanying gestures in vocal lessons.

1.7 Fieldwork and learning to perform as a research technique

The main period of fieldwork for this thesis began in 2012; however, my experience of learning to play Karnatak music started several years before this. Between 2008 and 2011 I spent long periods in South India learning to play Karnatak violin, the last three years of which were as a student of the violinist T.V. Ramanujacharlu (hereafter TKV). TKV works as a staff artist at the All India Radio station based in Tiruchirappalli, a large city in central Tamil Nadu. Many professional musicians in India work at the various branches of All India Radio (hereafter AIR), the national publically funded broadcaster. In addition to his work for AIR, TKV performs as an accompanist and as a soloist, and also teaches students from his home in the pilgrimage town of Srirangam, just outside of Tiruchirappalli. It was in Srirangam that I stayed on several occasions, for between three and five months each time, in order to take regular lessons with TKV.

Ethnomusicologists have often engaged in learning to perform a musical instrument as a research technique (Baily 2001). While this has the obvious benefit of providing insight into the process through which performers develop their skill, it can also lead to a deeper understanding of the structure of the style, described by Baily (2001) as apprehending the structure of the music 'operationally' (2001, p. 94). In addition, engaging with the learning process affords increased opportunities for participant observation, better understanding of the role and status of musicians encountered, and increased likelihood of continuing to interact with the participants, particularly those with links to your teacher, after the initial fieldwork period is over (2001, pp. 93-96). It is worth noting, however, that an outsider's experience of learning the style may differ from that of local students, either as a result of being treated differently by the teacher, or due to the influence of the student's previous musical background. I was aware, for example, that I had to make an effort to unlearn habits developed while previously studying Western classical violin. However, even 'local' students' experiences tend to differ as a result of their distinct musical backgrounds and

whether or not they are favoured by the teacher. Careful observation and comparison of one's own experiences with those of other students can help minimise the chance of false conclusions being drawn.

In the course of my PhD research I conducted three periods of fieldwork in South India, visiting more than thirty musicians to conduct interviews and observe lessons. I made video-recordings of lessons given by fifteen of the musicians, and in these cases interviewed both teacher and student after the lesson was over. Multiple visits were made to a few of the performers, sometimes to video another lesson and sometimes to watch and discuss the video that I had previously recorded with them. I recorded vocal, violin, *vīṇā*, and *nāgasvaram* lessons, and observations from all of these have contributed to this thesis. However, the analyses presented here are drawn from vocal lessons for the examination of the role played by co-singing gesture (chapters 4 to 8), and demonstrations of Karnatak violin *rāga ālāpana* for the analysis of musical structure (chapter 3). Detailed descriptions of the methods used will be given in the relevant chapters.

1.8 Thesis outline

The chapters contained within this thesis and the questions raised therein are as follows:

Part One: Gesture and Karnatak Music Structure

Chapter 2 opens with an overview of the historical and social context of the Karnatak style and a brief description of contemporary performance practice. This is followed by discussion of some of the conflicts between theoretical and practical conceptions of melodic elements in the style, drawing on the writings of musicians and musicologists as well as my own experience of learning to play Karnatak violin. The aim in this chapter is to present a way of conceptualising Karnatak melodic structure consistent with practice rather than theory. It is proposed that melodic units combining *svara* (scale degree) and *gamaka* (ornament), as well as longer motifs and phrases made up of sequences of such units are significant from a performance perspective and fundamental to the structure of the Karnatak style. Finally, the gestural qualities of such units are discussed.

Chapter 3 presents a joint musical and motoric analysis of a short extract of violin *rāga* performance. The aim here is to produce an analysis of melodic movement based on the dynamic processes that form the style, drawing on an examination of the sound-producing gestures with which it is performed. I propose here that the Karnatak style can be

characterised as coarticulatory in nature, due to the influence exerted by context on the performance of some of the basic melodic elements.

Part Two: Physical Gesture in Karnatak Vocal Lessons

Chapter 4 provides an introduction to the analyses of hand gestures in vocal lessons that constitute the second part of this thesis. Here I present details of the pedagogic process in South India and provide background information on the teachers whose lessons and opinions are discussed in the chapters that follow. The ethical dimension of gesturing in pedagogic and performance contexts is also considered.

Chapter 5 presents a discussion of the opinions of vocal teachers and their students on the role played by hand gestures in lessons. The material analysed is drawn from interviews with over thirty musicians and students conducted in the course of my research. Here I seek to clarify what, if anything, teachers and students understand to be indexed by teachers' hand gestures, and how such indexing contributes to the pedagogic process.

Chapter 6 presents an analysis of the relationship between hand position and musical pitch using a combination of quantitative and qualitative methods. A subset of phrases from three vocal lessons given by different teachers is analysed in order to determine the extent of mapping between the two domains. Qualitative analysis is used to consider the differences in mapping observed amongst the three teachers, and also the evolution of correspondence between pitch and hand position during particular pedagogic interactions. The role played by gestures in the segmentation and comprehension of phrases is also discussed.

Chapter 7 examines gestural indexing of musical qualities such as emphasis, attack, release, and change in loudness and timbre. Fourteen pedagogic interactions are analysed. Mappings between hand gesture and musical qualities observed are discussed with reference to the physical and experiential basis of such mappings, as well as the metaphoric and iconic forms of gestural communication employed. The role played by such gestural indexing in conveying the musical motion required in the performance of a phrase is discussed.

Chapter 8 focuses on the interaction between teacher and student, enquiring into the role played by gesture in creating and maintaining common ground. The chapter presents analyses of sections from vocal lessons with reference to concepts drawn from the wider fields of gesture and communication studies, including grounding, gestural convergence, catchments, and addressee gestures. The contribution of such features to the learning process is discussed.

Chapter 9 summarises the main findings of the thesis and provides answers to the research questions posed in section 1.1. This is followed by a consideration of wider questions with respect to my findings, including discussion of gesture production theories and the contribution of physical gesture to thought. Finally, the connections between musical and physical gestures in the context of Karnatak music are considered, and suggestions for further research are made.

2 Karnatak Music: Theory and Practice

2.1 Introduction

Differences between the theory and practice of a musical style may arise due to the distinct aims of each endeavour, with musical practice aiming to satisfy either an audience or the performer and music theory typically attempting to systematise practice. In Karnatak music, the divergence between the two modes is evident and is a frequent point of discussion within Indian musicology. Here, the debate is typically cast as a conflict between *lakṣaṇa* and *lakṣya* (for example, Manikandan 2004), wherein *lakṣaṇa* (the definition) refers to theory and *lakṣya* (the object to be defined) refers to practice.[5] Due to the prominence of such discourses in the music of South India, when discussing Karnatak music it is important to distinguish between music as it exists in practice and that which is presented in theoretical works.

The distinction between theory and practice is relevant to the question posed in this thesis regarding the significance of gesture in Karnatak music structure, because, as I will argue, theory tends to be atomistic in its approach, taking the note or *svara* as the basic unit of music, while practice requires an additional gestural conception. Here, I follow Godøy (2011) who proposes that music can be understood as a series of 'gestural-sonic objects', in which atom events, such as musical notes, are subsumed under the physical gestures that create them, forming holistically perceived chunks of music (p. 67). In this chapter and the one that follows, I argue that Karnatak musicians hold two conceptions of the music, one that is based on motifs akin to Godøy's gestural-sonic objects, and another that is based on *svaras* (*rāga* scale degrees) – a more atomistic approach as defined by Godøy (2011). I suggest that the gestural, or motif based, perspective has been underexplored in Karnatak music theory and analysis, and here I provide evidence for its significance in the style.[6]

In the present chapter, therefore, I will lay the groundwork for my analytical approach by presenting a discussion of practical and theoretical conceptions of Karnatak music that are particularly relevant to an appreciation of gestural and atomistic approaches to the style. The chapter opens with a section outlining the historical and social context of Karnatak music, followed by an overview of the contemporary concert format and the musical forms typically presented therein. Having laid this groundwork, I present an introduction to some of the basic melodic units that form the style, and discuss the ways in which they are conceptualised in theory and in practice. Following this discussion, I propose the structural and aesthetic

[5] See Staal (1961, 1976, p. 105) for a discussion of the meaning of *lakṣaṇa* and *lakṣya* in Sanskrit philosophy of language, in which the former refers to a grammatical rule and the latter refers to its object.

[6] Sections of both this and the following chapter have been published in Pearson (2016).

significance of *svara-gamaka* units (units comprising the ornament performed on a scale degree), and longer motifs and phrases made up of chains of such units. Finally, I discuss the gestural qualities of such motifs.

2.2 Historical and social context of the Karnatak style

The Karnatak style, as it exists today, draws from a number of musical traditions and contexts, including music that was played at royal courts, temple music, and devotional song (Qureshi 2001). As the style has historically been transmitted orally, the primary sources for understanding performance practice before the advent of sound recording are musical treatises and iconography (Powers and Katz 2001, p. 155). Early treatises include the *Nāṭyaśāstra*, a record of dramatic theory, music, poetics, and aesthetics from the 4th and 5th centuries, attributed to Bharata; the *Bṛhad-deśī* from the 8th century, attributed to Mataṇga; and the *Saṅgīta-ratnākara*, composed by Śārṅgadeva in the 13th century (Powers and Katz 2001). While the precise origins of the first two treatises are unclear, Śārṅgadeva, the author of the *Saṅgīta-ratnākara*, was attached to the court of the Yādava King Singhaṇa, in Devagiri, in what is now southern Maharashtra (Ramanathan 2008). The *Saṅgīta-ratnākara* includes definitions of many of the musical terms used in contemporary Karnatak music (Shringy and Sharma 2007a, 2007b), the details of which will be discussed later in this chapter. In addition, descriptions of musical instruments and playing techniques show similarities to those found in the contemporary Karnatak style. For example, the double-ended drum, now referred to as the *mṛdaṅgam*, appears in the *Saṅgīta-ratnākara* as the *mardala* (Powers et al. 2001, p. 213), together with an outline of playing techniques that bear similarities to those used today. The *Saṅgīta-ratnākara*, also mentions various types of *vīṇā* (chordophone) (Dick et al. 2001, p. 643), a plucked version of which, known as the *vīṇā* or the *Sarasvatī-vīṇā*, is still performed.

Distinctions between South and North Indian musical styles can be inferred from references from at least the 16th century onwards (Qureshi 2001, p. 152; Powers and Katz 2001, p. 155), although N. Ramanathan notes that no explicit recognition of two distinct systems can be found before the 19th century (Ramanathan 1993, as discussed in Pesch 2009, p. 12). It appears that musicians moved back and forth across the Muslim and Vijayanagar courts in southern and central India between the 13th and 16th centuries, and that the common contemporary equation of northern (Hindustani) music with Muslim influence and southern (Karnatak) music with purely Hindu lineage is a result of the fact that the last developmental stages of these styles were based in Muslim Delhi and Hindu Thanjavur respectively (Powers and Katz 2001, p. 155).

There has historically been a great degree of interaction between musicians based in temples and at court. Temple performers in southern India were traditionally from caste groups that later constituted themselves under the name *Isai Vēḷāḷar*. Here, the primary ensemble is referred to as *periya mēlam* (great ensemble) consisting of *nāgasvaram* (shawm), *tavil* (double sided drum), and *tāḷam* (cymbals) (Viswanathan and Allen 2003, p. 82; Qureshi 2001). Such temple musicians were often also employed at courts; for example, the four brothers known as the Tanjore Quartet were employed as musicians and dancers at the court of Maharaja Serfoji II in his court at Tanjore in what is now Tamil Nadu (Weidman 2006, p. 30). Female temple dancers and singers from the same caste as *periya mēlam* musicians, sometimes referred to as *devadāsīs*, also regularly performed at court (Viswanathan and Allen 2003, pp. 70-71), and the work of court composers was integrated into their repertoire (Krishnan 2008).

As the royal courts suffered gradual decline in power and wealth during the 19th century, musicians looked to patrons in Madras (now Chennai) for support and opportunities to perform. As a result there was a gradual shift in patronage from the royal courts to the salons of the Madras elite, and finally to the public domain (Subramanian, L. 2006, p. 48). Local organisations, known as *sabhās* formed in order to organise concerts, paying artists through funds drawn from members' subscription fees. The earliest *sabhās* date from the beginning of the 20th century, with several important organisations being formed between the 1920s and 1950s (Weidman 2006, pp. 79-80). Thus the social context of musical performance altered considerably and as a result changes were required of the style in order that it might adapt to its new environments and social functions. Prominent members of various political, social, and religious organisations, including the Indian Congress Party, the wider nationalist movement, and the Madras Theosophical Society, exerted a strong influence at this time, calling for Karnatak music to be purified and standardised (Allen 2008; Subramanian, L. 2006; Weidman 2006). The All-India Music Conference held in Madras in 1927 announced that it aimed to 'correctly understand, improve and standardise' Indian music, and also to 'provide facilities for widespread instruction in music on correct and up-to-date lines' (Report of the All-India Music Conference, Madras, 1927, as cited in Weidman 2006, pp. 81-82). The conference led directly to the founding of the Madras Music Academy in 1928, the aims of which included the maintenance of purity and quality, as can be seen in the following statement made as part of an appeal for public support in 1935:

> In addition to arranging musical performances, it [the Madras Music Academy] is making every attempt to purify Indian Music and to set definite standards. Even the performances are so programmed as to educate the audience…. We run a Teacher's College of Music to train teachers who would maintain a pure standard in the art and

> who would provide the kind of tuition required by our younger generation, particularly the girls of our families. (Madras Music Academy 1935, as cited in Weidman 2006, p. 82)

The purification referred to twice in this extract relates in part to the perception that Karnatak music was tainted by the prominent role played by *devadāsīs* in the style. Due to their unmarried, courtesan status, *devadāsīs* had been subject to a prolonged attack since the latter part of the 19th century by a number of social reform movements (Subramanian, L. 2006, pp. 125-132). Various groups petitioned against *devadāsī* practices, which were finally banned in the *devadāsī* abolition legislation of 1947 (Weidman 2006, pp. 116-121). The purification of Indian music, as referred to by the Madras Music Academy, also meant the exclusion of parts of the repertoire that had erotic lyrical content, including many *padams,* a dance and song form that generally involved narratives of erotic love between women and gods (Subramanian, L. 2006, p. 135; Soneji 2011).

The music reformers, spearheaded by the founders of the Madras Music Academy, also sought to standardise musical performance, partly in order to better present it as a 'classical' tradition (Allen 2008, pp. 91-92). Early in the existence of the Madras Music Academy the Experts Committee was established to meet at the Academy's yearly conferences with the aim of resolving differences between theory and practice as well as between divergent practices (Allen 2008). The debates of this committee are discussed in section 2.6 of this chapter, as they shed light on some of the conflicts between theory and practice in the Karnatak style.

2.3 Concert format and improvisation in Karnatak music

The shifts in patronage and performance contexts described above also led to changes in the concert format. P. Sambamoorthy, a musicologist and influential member of the Madras Music Academy, noted in an article titled 'Our concert programme; Some underlying principles' that although the contemporary concert format was based on aesthetic principles derived from centuries of musical practice in royal courts, 'the vidvan [knowledgeable musician] who formerly delighted in expounding a raga for hours together and earned the encomiums of even his jealous colleagues, had to remodel his programme to suit the new type of audience' (Sambamoorthy 1944, quoted in Weidman 2006, p. 83). The implication here is that in the new concert format less time should be given to *rāga* improvisation and more to compositions (Weidman 2006, p. 83). The new concert format, therefore, consisted of many 'light' (short and brisk) compositions, performed without much improvisation, interspersed amongst a smaller number of 'heavier' (longer, slower, and composed in one of the more

serious *rāgas*) compositions, performed with sections of improvisation. This is the concert format still employed today in South India.

In 21st century Chennai, the majority of Karnatak concerts are vocal concerts, although some concerts led by instrumental soloists rather than vocalists can be found. The greater popularity of vocal concerts is largely due to audience interest in the religious lyrical content of the form, which of course can only be appreciated when the music is sung.[7] Vocal concerts are performed by a solo vocalist accompanied by a violinist and one or two percussionists, one of whom is always a *mṛdaṅgam* player. In addition, a drone will be provided, traditionally by a *tambūrā* (a large long-necked lute) (Powers et al. 2001). However, in contemporary concerts the drone is often replicated by an electronic instrument known as a *śruti* box or an equivalent digital application. Although the violinist performs an instrument identical to that found in western classical and folk music, the style of playing has developed considerably since it was first introduced to India by at least the mid-18th century (Weidman 2006, pp. 29-31). Details of Karnatak violin performance style will be discussed in the next chapter.

The main compositional form performed in concerts today is known as the *kriti* (sometimes referred to as *kīrtanam*) (Powers and Widdess 2001). These are song compositions, usually formed of three sections. The sections vary in their structure to some extent, but the general compositional approach is the presentation of a melodic line of either one or two metrical cycles in length, followed by increasingly intricate elaborations of that line. Other forms of composition frequently performed at concerts include the *varṇam*, conventionally thought of as a study, and the *rāgam-tānam-pallavi*, a complex format in which first a *rāga* and then a melodic line in that *rāga* is developed at length using various techniques. Shorter and lighter compositional forms sung at the end of concerts include *tillānās* (rhythmically complex pieces originally composed for dance), and *bhajans* (popular devotional songs) (Powers and Widdess 2001).

A typical concert consists of between seven and twelve compositions, opening with a *varṇam* and followed by one or two light *kritis*. The main body of the concert consists of two or three longer and more 'serious' *kritis* sandwiched between lighter compositions. The concert then ends with several short and very light compositions, often including a *tillānā*. The two or three longer *kritis* sung during the concert include various improvisational segments including *rāga ālāpana*: improvisation without metre sung before the composition; *niraval*: improvisation with metre on a line of text from the composition; and *kalpana svara*: improvisation with metre sung to the names of the *svaras* (pitch positions), played at the end

[7] Instrumentalists perform the same compositions as vocalists, and typically even learn the lyrics to the compositions, so as to appreciate their meaning and also render the composition with phrasing derived from the lyrics.

of the composition (Powers and Widdess 2001, pp. 208-210). In addition, a single percussion solo (*tāni āvartanam*) is performed after the *kalpana svara* section, typically at the end of the main composition in the concert.

It should be noted that in the Karnatak style, compositional and improvisational elements overlap: compositions may be modified by the performer and improvisations draw on many characteristic phrases handed down from teacher to pupil. The significant role played by pre-existing musical material in Indian improvisatory formats has been emphasised by Slawek (1998), Zadeh (2012) and Napier (2006). The overlap between improvisation and composition is discussed by Nooshin and Widdess (2006) in the contexts of Indian and Iranian music, where they conclude that the distinction between composition and improvisation is artificially rigid, as 'in practice there is a sliding scale between the spontaneous and the pre-planned, and the same performance may draw on elements from different points along that scale' (2006, p. 3) Furthermore, although the Karnatak improvisational forms discussed above (*rāga ālāpana*, *niraval*, and *kalpana svara*) are commonly referred to by musicians as *manodharma saṅgīta*, meaning music of the mind or heart, the use of such terms that distinguish between improvised and composed music appears to be fairly recent in the history of Karnatak music (Kassebaum 2000; Nooshin and Widdess 2006). However, in the absence of better ways to indicate higher and lower degrees of spontaneous and pre-planned content in music performance I will occasionally use the term improvisational in this thesis when referring to forms of *manodharma saṅgīta,* while recognising the presence of pre-existing musical material in such segments.

2.4 The intertwining of *svara* and *gamaka*

In Karnatak music, *svaras* and *gamakas* are among the smallest of the fundamental melodic units commonly referred to by performers. A typical definition of *svara* is provided by P. Sambamoorthy in his *Dictionary of South Indian Music and Musicians*, which states, 'that which pleases of its own accord is Svara or Musical note' (Sambamoorthy 1952/2007). However, as we shall see, *svaras* are not notes in the sense used in Western classical music, because, as Deva (1973) explains 'a svara is not strictly a static phenomenon' (p. 5).

There are seven *svaras* in an octave: *ṣaḍja*, *ṛṣabha*, *gāndhāra*, *madhyama, pañcama, dhaivata,* and *niṣāda*. These are often sung or referred to by their *sargam* syllables: a system of solmisation. The *sargam* syllables are *sa*, *ri*, *ga*, *ma*, *pa*, *dha*, and *ni*, and *sa* may be placed at any pitch. The *svaras* in a *rāga* are notionally placed at particular *svarasthānas*, or pitch positions, of which there are twelve possible positions in an octave. However, the pitches touched during a performance are not confined to a division of the octave into twelve equally spaced semitones. While contemporary books of Karnatak music theory usually cite the

existence of 22 *śrutis* (pitches) in an octave (for example Chelladurai 2005, p. 267), in practice the pitches played in many *rāgas* do not correspond to this or any other existing theoretical subdivision (Komaragiri 2013; Subramanian, M. 2002; see also Rao and van der Meer 2010 for a discussion of pitch in Hindustani music). In practice, teachers communicate the correct pitch positions for each *rāga* through demonstration alone, and research has shown that the pitch placement of *svarasthānas* varies between *rāgas*, and even, to an extent, between performers and performances (Komaragiri 2013). However, general tendencies can be found across different performances of the same *rāga*, and, as noted by Komaragiri (2013), the variability in intonation found does not suggest that any pitch is acceptable, but rather that there is a degree of latitude, with the characteristic pitch profiles constituting the '*rāga* gestalt' (2013, p. 151).

While *svara* names and *sargam* syllables are used to refer to a *rāga's* scale degrees and theoretical pitch positions, *svaras* are not equivalent to musical 'notes'. This is because while *svaras* as they exist in theory refer to a single pitch position, in practice they are frequently expressed through melodic fluctuations or ornaments known as *gamakas*. Viswanathan describes the relationship between *svaras* and *gamakas* in theory and practice as follows:

> Theoretically, one can define a svara simply as a scale degree (sa = tonic, pa = fifth, ni = seventh, etc.) or interval (ga flat, ma sharp, da natural), but in practice a svara is properly defined only when taking into consideration the gamaka(s) traditionally associated with it. (Viswanathan 1977, p. 31)

Similarly, Ramanathan asserts that 'svaras are not plain notes, but are complex aural shapes to which shakes and slides are integral' (2004, p. 12). From such comments, it can be seen that while *svaras* and *gamakas* are defined separately in theory, in practice they are inextricably linked. As my analysis is of performance practice rather than music theory, it will, therefore, be necessary to examine *svaras* and *gamakas* in tandem.

2.5 *Gamaka* and *bhāva: gamakas* in theory and in practice

Rāga is the primary melodic concept in Karnatak music, and one of the main goals of musical performance in this style is to express the *bhāva* (mood or feeling) that is particular to each *rāga*. A *rāga* can be simply described as a 'melody type' (Pesch (2009, p. 472); however, the features that define such melody types are complex. The *bhāva* of a *rāga* is created through *sañcāras* (characteristic phrases) comprising the *svaras* of that *rāga*, performed at particular *svarasthānas* and using particular *gamakas* (Pesch 2009, p. 472) The term *gamaka* is often

translated as ‘ornament’, however in Karnatak music *gamakas* cannot be considered mere embellishments, as they convey fundamental information regarding the *rāga* and its associated *bhāva* (mood or feeling). As Viswanathan notes, ‘Gamaka forms an integral, rather than decorative function in Indian music’ (1977, p. 31). Convention dictates which *gamakas* should be played on each *svara* in a given *rāga*, and if the appropriate *gamakas* are not used when performing a *svara* sequence, the mood of the *rāga* will not be properly expressed (see Viswanathan 1977; Powers and Widdess 2001; Pesch 2009). Viswanathan explains this with some examples:

> Gamaka is what gives a rāga its unique character; thus, although the rāgas śaṅkarābharaṇam and kalyāṇi both take *catusśruti riṣabha* (the major second) the svara *ri* is treated very differently in each case. This difference may be described substantially in terms of gamaka. (1977, p. 31)

The easiest way to disambiguate two similar *rāgas* can often be through differences in their *gamakas*, a point made by Kassebaum (2000) who notes, ‘When two ragas have the same scale pitches, the integrally associated ornamentation of certain tones serves to differentiate between the two’ (p. 93).

In performance, *gamakas* can be heard as wide and narrow pitch oscillations, fleeting leaps, turns around a central pitch, and slides with various types of emphasis. The forms taken by *gamakas* are extremely numerous: Viswanathan notes that it is ‘virtually impossible to make an exhaustive list of all gamakas’ (1977, p. 32). Nevertheless, *gamakas* have historically been categorised in musical treatises into a limited number of types, and are still presented as such in contemporary books of music theory (for example, Bhagyalekshmi 1990). Prominent typologies of *gamaka* include the 13th century *Saṅgīta-ratnākara* (see Shringy and Sharma 2007b), the early 17th century *Rāga-vibhoda*, and Subbarāma Diksitar’s *Sangitā-sampradāya-pradasinī* published in 1904 (see Powers and Widdess 2001, p. 190; Powers 1959, p. 134). In addition, more recent typologies have been presented in Powers (1959) and Kassebaum (1987). Such classificatory systems tend to present similar but not precisely the same set of *gamakas*, with their mode of description and grouping differing in each treatise. In order to demonstrate their diversity, I will describe a few of these systems. The *Saṅgīta-ratnākara* lists fifteen gamakas, described as ‘varieties of *kampa* (shake)’ (Shringy and Sharma 2007b, p. 172) and categorised according to quality and speed. From faster to slower these shakes include, ‘*sphurita*’ (lit. trembling, throbbing, quivering), ‘*kampita*’ (lit. shaking), and ‘*āndolita*’ (lit. swung) (2007b, p. 172). Meanwhile, the R*āga-vibhoda* (1609) by Somanātha, presents twenty-three *gamakas* each described through the vīṇā technique required to play them. Types of *gamakas* here include not only shakes of

various types but also grace notes and ways of stifling the tone (Powers 1959, pp. 129-131). Subbarāma Diksitar's *Sangitā-sampradāya-pradarsinī* gives symbols for only ten *gamakas* with symbols for each that can be placed above or next to *svara* names in notation (see Powers 1959, p. 134). Finally, Powers (1959) bases his typology on that of Subbarāma Diksitar, similarly dividing his ten *gamakas* into three groups: deflections (oscillations such as *kaṁpita*), slides (including *jāru*), and fingered stresses (such as *janta*) (1959, p. 147).

Such categorisations may indeed be useful for ease of reference when seeking to discuss some of the melodic fluctuations found in the style. However, the limitations of *gamaka* typologies have been noted. For example, Viswanathan observed that the multitude of subtle variations in the performance of *gamakas* tend to defy systematic classification (1977, p. 32). As a professional Karnatak musician of the highest calibre, Viswanathan was well placed to know whether *gamaka* typologies could adequately account for the range of fluctuations found in performance, and so his reservations here should be pondered. While *gamaka* typologies are taught in theory classes at music colleges, such terms are rarely used in practical vocal and instrumental lessons; music tuition in South India proceeds largely through demonstration and imitation, with verbal explanation typically kept to a minimum. Furthermore, I have never observed a teacher using *gamaka* symbols, such as those presented in *Sangitā-sampradāya-pradarsinī* (see Powers 1959, p. 134), when writing out *sargam* notation for their students, with the exception of once seeing a teacher place a wavy line over a *svara* that a student had forgotten to oscillate. I would suggest, therefore, that the relative absence of *gamaka* typologies in practical music lessons points to their limited usefulness for performers, which in a style that includes a high proportion of improvised content should be considered a perspective of great significance. Therefore, in line with Viswanathan's reservations I avoid conceptualising *gamakas* through typologies in this thesis, and instead treat them as a multiplicity of melodic fluctuations that serve a number of functions, which include expressing the *bhāva* of the *rāga* and creating links between one *svara* and the next. These functions will be discussed further in the remainder of this and the following chapter. However, first, I will explore some of the apparent contradictions between theory and practice in Karnatak music.

2.6 Divergence between scalar and motif-based approaches

As can be seen from the *gamaka* categories discussed above, shakes and oscillations are highly prevalent in the style. *Gamakas* formed of wide pitch oscillations are particularly characteristic, and typically do not rest on the pitch theoretically indicated by the *svara* but instead imply the pitch through an oscillation that slides between two pitches on either side of the tone indicated. For example, in *rāga* Toḍi, the third degree of the *rāga*, *ga*, is often played

as an oscillation between the pitch below and pitch above that which is indicated by the *svara's* name. To illustrate further, if the tonic, *sa*, is placed on A, the theoretical pitch position of *ga* is C. However, in *rāga* Toḍi, *ga* is sometimes performed as a *gamaka* that starts on B♭ and then oscillates, sliding between B♮ and D, without dwelling on C at any point (see Figure 2.1).

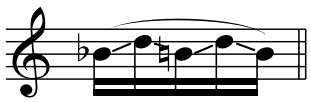

Figure 2.1: A way of playing *gāndhāra* in *rāga* Toḍi, if *ṣaḍja* is placed on A. The pitches shown here are performed with a vocal or instrumental motion that creates a sonic 'sliding' effect between tones.

An additional confusing factor is that while B♮ is prominent in the *gamaka* used to play *gāndhāra* in this *rāga*, it does not appear in the theoretical 'scale' of Toḍi when *ṣaḍja* is placed on A.[8] Although these aspects of *rāga* performance may seem perplexing to those unfamiliar with Karnatak music, they are common in the style and something that students learn to accept early in their learning process. Oscillations expressing a *svara* without actually resting on the pitch at which it is theoretically placed, exist in many important Karnatak *rāgas* including Śaṅkarābharaṇam, and Bhairavi, and the emphasis of pitches that lie outside of the theoretical *rāga* scale also occurs in *rāgas* such as Asāvēri and Madhyamāvati (Krishnaswamy 2004). This feature of Karnatak music is referred to by the musicologist N. Ramanathan when he notes, 'In practice, quite often a svara might originate from or/and involve touches of svarasthāna-s that are not associated with the rāga at all' (2004, p. 13).

Such variance between the scalar conception of *rāga* and what occurs in practice demonstrates the extent to which the scalar system that has come into use in Karnatak music is inadequate and, in fact, misleading if one is to either understand or analyse the style. The scalar system, referred to as the *meḷakartā* system, is a purely theoretical construct, the origins of which were presented in musical treatises in the 16th and 17th centuries (Pesch 2009, pp. 169-170). The main precursor of the *meḷakartā* system of *rāga* scales used in south India today was described in the 17th century treatise, *Caturdaṇḍī-prakāśikā*. Here, the author Veṅkaṭamakhin presented a system of 72 scale types (*meḷakartā* or *meḷa*) created through permutations of the semitonal scale of pitches produced by the fixed-fret *vīṇā*. Veṅkaṭamakhin proposed that only 19 of the *meḷa* were necessary in order to account for the

[8] Krishnaswamy (2004) acknowledges the presence of this 'foreign' pitch in the *gamakas* used to play *ga* in Toḍi when he states, '[t]here are also ragams which use entities anchored on swarasthanams that are not part of the ragam. For example, in Thodi, R2+ appears as a particular form of G2 sometimes' (2004, p. 2). The term R2+ here refers to a combination of tones including a sharpened *ri*. Further details on Toḍi as it exists in theory and practice are given in section 3.5 of this thesis.

rāgas in existence at the time, and he named each of those 19 *meḷa* after the most prominent *rāga* belonging to it (Powers and Katz 2001; Powers and Widdess 2001).

As a theoretical endeavour, Veṅkaṭamakhin's proposal appears harmless. However, some musicologists have noted that subsequent enthusiasm for the 72- *meḷakartā* scheme has led to unwelcome changes in the way certain *rāgas* have come to be conceptualised and performed. Notably, in an article titled 'The Melakartā – a critique' (1938), the musicologist K. V. Ramachandran argued that the *meḷakartā* system was partially responsible for deforming comprehension of certain *rāgas*. He argued that originally the *meḷas* were simply labels with a classifying sense, and were not intended to define the *rāga*: rather it was the *rāga* that defined the *meḷa* (1938, p. 31). Indeed, the *rāga* after which a *meḷa* was named often did not include all of the *svaras* in the *meḷa* (Pesch 2009, p. 170). Furthermore, as previously noted, when Veṅkaṭamakhin initially proposed the system *rāgas* were only in existence for 19 of the 72 possible permutations. Nevertheless, the system was enthusiastically seized upon by subsequent generations of theoreticians, and composers; new *rāgas* were created to fit the remaining 53 *meḷa* scale permutations, and the *rāga* after which a *meḷakartā* is named must now include all seven *svaras*. Ramachandran describes the shift in perspective thus:

> Unfortunately, current musical belief amongst professional musicians as well as theoretical experts is that the Melas [are] the parents and the Rāgas are the offspring, that the Mela implies svara taboos and that the Aroha [ascending] and the Avaroha [descending] sañcāras are sufficient to define the Rāga. (Ramachandran 1938, p. 31)

Although Ramachandran's last point appears overstated, I have never met a Karnatak musician who felt that the ascending and descending pitches in a *rāga* scale were sufficient to define a *rāga*, his belief that the emphasis on the *meḷakartā* system has tended to deform performance practice by giving the impression that certain *svaras* in a *rāga* are taboo has some basis. Evidence for this can be seen in the exchanges that took place amongst members of the Madras Music Academy Expert Committee at its meetings between 1930 and 1952, during which members focussed on *rāgas* that failed to fit into any of the existing *meḷas*, and attempted to find ways of making them do so, occasionally by suggesting changes in performance practice (Allen 2008).[9] Krishna and Iyer (2012) also argue that enthusiasm for the *meḷakartā* system has led to changes in the performance of pre-existing *rāgas*, providing the example that certain characteristic phrases of *rāga* Begaḍa have gradually disappeared

[9] Allen (2008) provides a discussion of these debates, while sections of the debates themselves can be scrutinised in issues of the Journal of the Music Academy of Madras published between 1930 and 1952.

from performance practice because they do not fit the theoretical *rāga* scale allotted to Begaḍa (2012, p. 16).

Ramachandran (1938) argued that *rāgas* are 'far too intricate to be defined by any mechanical formula based exclusively on svaras'. Instead, he maintained that *rāgas* should be defined not only by *svara* scales but also through their 'characteristic figures and exclusive phrases' as well as 'movements of various kinds': the first clearly referring to *sañcāras* and the second likely alluding to *gamakas* (1938, p. 31). Powers (1959) had sympathy with Ramachandran's position, describing the South Indian *rāga* system as having 'very little to do with the scale-system' and emphasising the importance of 'rāga-phrases' in the style (1959, p. 87), as can be seen in the following statement: 'For, just as the scales have been much over-stressed in their connection with the nature of the rāga-system, so also has the phrase-structure been much neglected in the same connection' (Powers 1959, p. 87).

While Powers focused on the significance of 'rāga-phrases', which are in effect the *sañcāras* previously referred to, he also quoted Indian musicologists and musicians who viewed the increased emphasis on *rāgas* scales as leading to the loss of nuance in the performance of *gamakas*, as in the following quote from the vocalist and musicologist Venkatarama Iyer (quoted in Powers 1959):

> Ancient and natural ragas, which cannot be defined in terms of svaras, and which can be pictured only by the imagination, are falling into desuetude. […] I am in fear that those finer shades called 'Gamakas' (graces/ornaments) which breathe life and melody in ragas will gradually disappear; and we shall have instead regular modes with clear-cut svaras, with no grace, with no beauty, and with no life. We shall have lost natural living persons, and shall have got instead brilliant dolls. (Venkatarama Iyer as quoted by Powers 1959, p. 99)

Such arguments support the idea that *rāgas*, although frequently defined by scales in music theory, are not primarily scalar in nature, but instead are better defined through their characteristic phrases (*sañcāras*), as well as through shorter motifs comprising characteristic *gamakas* performed on *svaras* present in the *rāga*. In the following section, I will examine the significance of such shorter melodic units, here termed *svara-gamaka* units, in more detail.

2.7 *Svara-gamaka* units

Considering that in the performance of certain *svaras*, the theoretical pitch degree is not touched directly but implied, as in the case of *gāndhāra* in *rāga* Toḍi (discussed above), I suggest that there is a sense in which the *svara* name acts a placeholder for a motif that

expresses the *svara* as it should appear in that *rāga*. Morris (2011) takes a similar position in his analysis of two Karnatak *varṇams* (*études*), explaining that it is conceptually incorrect to characterise *gamakas* as ornaments embellishing a particular pitch, and that instead a more accurate approach is to consider that there are a number of possible ways to perform a *svara* in a given *rāga* (2011, p. 16). His analysis of two recordings of *varṇams* in *rāgas* Kalyāṇi and Bhairavi demonstrates this latter approach. Here, Morris (2011) transcribes and lists the different melodic motifs used to realise each *svara*. In the recording of a *varṇam* in *rāga* Kalyāṇi, for example, Morris finds between four and eleven different motifs used to perform each of the *rāga's svaras* (2011, pp. 20-21). I would suggest that the analytical approach used by Morris here supports the significance of the *svara-gamaka* unit for the analysis of Karnatak music.

The pitches touched within *svara-gamaka* units in addition to or instead of the named *svara* pitch are referred as *anusvaras* (Pesch 2009, p. 394). It is important to note that such briefly touched pitches, including those that lie outside of the theoretical *rāga* scale, are not random or subject to the whim of the performer, but rather are integral to the proper performance of the *svaras*. Therefore, a degree of precision in pitch, rhythm, and emphasis is required in order that the performance of the *svara-gamaka* unit should conform to unwritten conventions. For example, my Karnatak violin teacher clearly maintains that there is a right and wrong way to play the *gamakas* on each *svara* in a *rāga*, as he took great pains to correct errors of intonation or emphasis in my performance. Such precision is important because if the *gamaka* on a *svara* is not performed correctly a different *rāga* may be implied or the *rāga bhāva* (mood of the *rāga*) may be lost. However, pitch analysis studies of Karnatak music recordings have found that the pitches touched during *gamakas* do vary to some extent across performers and performances (see Komaragiri 2013; Subramanian, M. 2002, 2007; Krishnaswamy 2003). So there remains the somewhat confusing scenario in which musicians hold precision in the performance of *gamakas* to be important, while in practice there exists a degree of pitch variation between individual musicians' renditions of the same *svara-gamaka* unit. It may be that precision in pitch is important only to an extent, with the style displaying a certain degree of latitude, particularly in fast passages or for briefly touched pitches. Alternatively, it is possible that certain points of *svara-gamaka* units require precision, while others may be treated more loosely. A third interpretation of the evidence is contributed by Komaragiri (2013) who concludes that intonation in Karnatak music is dynamically variable rather than acoustically based, and is dependent on immediate musical context and the performers' perception (p. 153). Further research is required on such issues; however, this lies outside the scope of the present thesis.

Importantly, accurate pitch is only one of the elements required for the correct rendition of a *svara-gamaka* unit, with rhythm and emphasis also being critical. Indeed, there

are cases in which the overall gestural quality of a *svara-gamaka* unit seems to hold equal significance to the pitches touched during its performance (for example, see the discussion of phrase 4 in section 3.6 of this thesis). The gestural qualities of *svara-gamaka* units, and the longer motifs and phrases formed from chains of such units will be discussed further in the following section, explored through statements made by musicians and my own experience of learning to perform the style.

2.8 Gestural qualities of *svara-gamaka* units

The characteristic mood of a *rāga*, its *bhāva*, arises from a combination of elements including the *svarasthānas*, *gamakas*, and *sañcāras* from which it is formed (Pesch 2009, p. 472; Viswanathan 1977, p. 31). As will be shown in the discussion that follows, two different *rāgas* with the same *svarasthānas* may have quite different *bhāvas*; therefore, *gamakas* and *sañcāras* can be viewed as playing a more important role in conveying *bhāva*. *Sañcāras* are phrases that are characteristic of a *rāga*, formed from sequences of *svaras* rendered with the required *gamakas*. *Sañcāras* may be brief, consisting of only three or four *svara-gamaka* units, or rather longer. While the shorter *sañcāras* may be experienced as a single 'gestural-sonic object' (Godøy 2011), in which individual atoms (in this case *svaras* and *anusvaras*) are subsumed under the physical motion required to produce them, longer *sañcāras* may be comprised of several such musical gestures. Reference books of South Indian *rāgas* often provide a few *sañcāras* for each *rāga*, in the form of a simplified *sargam* notation (for example, Bhagyalekshmi 1990; Chelladurai 2005), however, only Karnatak musicians will understand how to realise such notation, using the *svara-gamaka* units that are traditionally performed in that *rāga* and in that particular melodic context.

Musicians are particularly aware of the role played by *gamakas* in conveying each *rāga's bhāva*. For example, the flautist and musicologist T. Viswanathan noted that 'Gamaka is what gives a raga its unique character' (Viswanathan 1977, p. 31).[10] Similarly, during an interview I conducted in Chennai, the violinist Vittal Ramamurthy stated that 'the *gamakas* make the raga […] unique', illustrating this comment by explaining that the *svaras madhyama, gāndhāra,* and *riṣabha* are theoretically placed at the same pitch positions in *rāgas* Kāmbhoji and Śaṅkarābharaṇam, and that it is the *gamakas* traditionally performed in each that separate the two *rāgas* (V. Ramamurthy, personal interview, Chennai, December 16, 2013).

[10] Here, Viswanathan uses the word *gamaka* not in the sense of its theoretical *gamaka* category, but to refer to the *gamaka* as it is played on a *svara* in a particular *rāga*, as his discussion of the intertwining of the three terms in practice makes clear (see Viswanathan 1977, p. 31).

Such differentiation based on *gamaka* can be seen in a demonstration given by T.V. Ramanujacharlu (hereafter TKV) on the difference between two *rāgas* comprised of the same *svaras*, theoretically placed at the same *svarasthānas*: Kēdāragauḷa and Surutti. TKV remarked, 'we can bring out [the] different moods [of] these ragas, with different *gamakas*' before demonstrating phrases highlighting the characteristic *gamaka* played for *riṣabha* in Kēdāragauḷa, which employs the motif *ga-ma-ri*. TKV then compared this to Surutti which has a far simpler, less elongated *gamaka* down to *riṣabha*, in addition to other differences including more emphasis placed on *niṣāda* and *madhyama* (Media File 2.1, showing TKV's demonstration of Kēdāragauḷa and Surutti, Warangal, July 4, 2012). In this demonstration, TKV shows that the distinct character of the two *rāgas* is created through their particular *gamakas* and *sañcāras*. Students also often have a good understanding of this relationship between *gamaka* and *bhāva*. Madhuri Kaushik, a student of Sukanya Prabhakar, a vocalist based in Mysore, explained particularly clearly: 'So when you sing a *kriti* [sings a few phrases from a *kriti*] you're actually giving the *bhāva* in that through the *gamakas*' (Madhuri Kaushik, personal interview, Mysore, July 25, 2013).

As *sañcāras* are formed from strings of *svara-gamaka* units, their influence on the expression of *rāga bhāva* cannot be disentangled from the units of which they are comprised. Such characteristic phrases play an important role in expressing the mood of the *rāga*. In the following interview extract, the Bangalore based vocalist, T.S. Sathyavathi (hereafter TS), stresses the unique contribution of each *sañcāra* and melodic 'movement' to the evoking of 'emotion':

> Once you hear the particular *sañcāra*, the *saṅgati* or that movement, it evokes a particular kind of emotion in you. To evoke that definite emotion, you have to have that particular and no different *sañcāra*. (TS, personal interview, Bangalore, August 11, 2014)

Significantly, it is not sufficient that a *sañcāra* or *gamaka* be performed with the correct pitches and rhythm in order for it to successfully convey a *rāga's bhāva*. In addition, it should possess the correct patterning of other musical qualities, such as emphasis, attack, release, and change in loudness. On several occasions during the lessons and interviews recorded, TS uses the term *uccāraṇa* to refer to the details of how a *gamaka* should be sung. The Sanskrit term *uccāraṇa* literally means 'articulation'; however, Sanyal and Widdess (2004) note that in Hindustani music the term can be used to refer to details of *svara* performance, including the way a *svara* is approached, quitted, and oscillated, as well as its loudness or softness (2004, p. 8). The term does not appear to be used widely amongst Karnatak musicians, and it is possible that TS adopts the word as a result of her background as a Sanskrit scholar. In the

following quote, she uses the term whilst explaining that *gamakas* should be sung with the correct musical articulation in order to convey the appropriate *bhāva*:

> I sometimes tell them "no, no bring in that *bhāva*, it's dry, it's not the right way", and we call it *uccāraṇa*. *Uccāraṇa* is actually articulation […], "articulate it properly, that's not the way that *gamaka* has to be sung", and I sing, then repeat, I sing, then repeat. (TS, personal interview, Bangalore, August 17, 2013)

My own experience of studying violin corresponds with the scenario described here by TS. It was evident from pedagogic interaction with my teacher that *svara-gamaka* units should be performed with specific qualities of musical articulation for them to be considered correct; for example, my teacher would play phrases repeatedly in order that I might reproduce details such as emphasis, attack, release, and dynamics correctly. In the initial stages of learning Karnatak violin, I struggled in my attempts to reproduce certain *svara-gamaka* units properly. Initially I thought of such units as pitches that had to be touched with a certain rhythm, but even when pitch and rhythm appeared to be correct my teacher frequently considered my rendition to be unsatisfactory. It was only when I started to perceive the underlying physical gestures used to perform such motifs that I became more successful in my imitation. In particular, I had difficulty imitating certain oscillations. I remember struggling to emulate the oscillations required for a *kriti* in *rāga* Gauḷa. My teacher would repeatedly remind me to hold the fingers of my left hand close together when performing the oscillations, but somehow my rendition was still lacking. Finally, one day he told me to hold my fingers together as though they were a tightly closed flower bud, and with this image in mind I was able to produce the oscillating gesture correctly. After experimenting more with the *gamakas* in this *rāga*, I realised my error had been in not realising the extent of the closeness and tension required in my fingers, both of which I was able to understand through the image suggested by my teacher. In this case, correct performance of the *svara-gamaka* units required insight into the physicality of the hand motion, including the qualities of muscular activation involved.

Rice (1994) reports a somewhat similar experience arising during his time learning the *gaida*, a form of bagpipes, in Bulgaria. He describes that his original approach to learning involved transcribing recordings of his teacher's playing into staff notation. This, however, simply reinforced his habit of conceptualising the music as compartmentalised into notes, ornaments, and expressive markings such as accents (pp. 81-83). Aware that he was unable to precisely imitate some of the motifs performed by his teacher, Rice subsequently achieved a breakthrough by realising that the motifs in question should be conceptualised in terms of hand motion rather than as note, accent, and ornament:

> I had made a distinction between accent and mordent and melody note, but now I realised that they should be integrated into a single concept located in a mental and physical image of how the hand worked to produce a complex of sounds [...] my new understanding added the hand motion necessary to produce the sounds: physical behavior became part of the conceptual source generating musical ideas. (Rice 1994, p. 83)

Rice describes his new approach as a conceptual unity 'of melodic concepts and physical schemata' (Rice 1994, p. 83). This acknowledgment of a bodily conceptualisation of musical phrases is reminiscent of Baily's (1985) question regarding the way in which performers represent musical patterns cognitively as patterns of movement as well as patterns of sound (1985, p. 237). Evidence for a connection between melodic and physical schemata can be found in the actions and testimony of musicians. For example, I have frequently caught myself moving the fingers of my left hand as though playing the violin when mentally (silently) 'singing' through a composition that I know fairly well. When asked whether he had similar experiences, the violinist Vittal Ramamurthy replied 'Yes. You sometimes think with the hand movement' (V. Ramamurthy, personal interview, Chennai, December 16, 2013). The pianist and musicologist, Mine Doğantan-Dack hypothesised that 'performers do not learn, represent and store rhythmic-melodic units without their accompanying gestural and expressive dimensions' (Doğantan-Dack 2011, p. 251). Thus, based on such testimony, it appears that at least some musicians conceive of musical phrases as both sound and gesture.

In the scenario described by Rice (1994), through conceiving melody and physical schemata as a conceptual unity he was able to perform a melodic element correctly. My own experience of a breakthrough in performing *gamaka* differed somewhat, as I had not been in the habit of understanding *svara* and *gamaka* as separate for some time, although this had been the case when I first began learning the style. However, I still lacked insight into the physical gesture required to reproduce certain *svara-gamaka* units correctly. The Karnatak musicians whose teaching I have observed tend to be very precise about what I refer to here as the 'gestural' qualities required from *svara-gamaka* units as well as the longer motifs formed from strings of such units. I use the term 'gestural' to refer to patterns of emphasis, attack, release, and change in loudness and timbre for the following reasons. Firstly, and most obviously, such patterns are created through the physical gestures of musicians, and it is the qualities of the physical gestures that are responsible for forming the specific patterns of musical features such as emphasis and change in loudness. Secondly, looking beyond the performer's experience, patterns of emphasis, attack, release, and change in loudness and timbre are those that convey to the listener the gestures used to create them. As discussed in

section 1.5.3 of this thesis, ecological approaches to music perception propose that, alongside rhythm, it is the patterning of emphasis and change in loudness that conveys the sound-producing gestures of musicians (Windsor 2011; Clarke 2001; Shove and Repp 1995). In everyday life, our physical gestures have the potential to create sound if they come into contact with objects. Thus, gesture and sound are inextricably linked in our experience, and the qualities of each can be understood to some extent from the other.

During lessons recorded in the course of my research, teachers often demanded precise gestural qualities in their students' renditions. Several examples will be given in chapter 7 of this thesis, but in order to illustrate this point here I will present an example from a lesson in *rāga* Śaṅkarābharaṇam given by TKV to his student Sevia, in Srirangam in August 2013. Here, TKV sings a phrase at the end of which there lies a movement from *riṣabha* to the tonic, *ṣaḍja*. In this *rāga* and context, the *gamaka* on *riṣabha* should be performed with an emphasis on *gāndhāra*, which, however, is sounded only very briefly before moving to *riṣabha*. This *riṣabha* is held for a moment following which there is a slight rebound motion up to a subtle *gāndhāra* before the phrase falls to the next *svara*: *ṣaḍja* (see Media File 2.2 at 0'01", 0'06", and 0'12"). On the student's first attempt, she misunderstands the motif, and instead sings a rapid oscillation between *gāndhāra* and *madhyama* before descending to *riṣabha* (Media File 2.2 from 0'04" to 0'05"). TKV subsequently repeats the phrase three times in an attempt to convey the correct patterning of pitch, emphasis, and articulation. This *svara-gamaka* unit, which is the motif typically used to perform *riṣabha* in descending phrases in Śaṅkarābharaṇam, appears frequently in this *rāga*, and also caused me some difficulty in the initial stages of learning. The student should grasp that the first *anusvara* on *gāndhāra* is brief but accented and followed by a longer but relatively less accented *riṣabha*. In addition, the rebound back up to *gāndhāra* should strike the correct balance: subtle but still present.

This way of performing *riṣabha* is not a momentary whim of the teacher. TKV is consistent in wanting this *svara-gamaka* unit to be performed this way across different lessons and instruments. In Media File 2.3, we can see TKV teaching the same *svara-gamaka* unit as part of a slightly different phrase from Śaṅkarābharaṇam to a young violin student. In this case the student fails to imitate the gestural qualities precisely, notwithstanding many repetitions by TKV at different octaves and several instructions as to the *anusvaras* that should be played within the *svara-gamaka* unit (for example, Media File 2.3 from 0'10" to 0'11"). Finally, TKV moves on to another phrase.

The gestural qualities required here on *riṣabha* are not particular to TKV's conception of the *rāga*; all knowledgeable performers perform *riṣabha* in this melodic context in a similar way. For example, Media File 2.4 shows the esteemed vocalist Sanjay Subrahmanyan performing the same *gamaka* on *riṣabha* with a similar pattern of emphasis

(Media File 2.4 at 0'02" and from 0'05" to 0'06"). Interestingly, he also makes a double-handed, pulling hand gesture while singing the *riṣabha* (Media File 2.4 from 0'05" to 0'06") that mirrors the single-handed pulling gesture used by TKV while teaching the same *svara-gamaka* unit (Media File 2.2 at 0'12"). Therefore, it can be seen that the *svara-gamaka* unit on *riṣabha* as it moves down to *ṣaḍja* in this *rāga* has a patterning of emphasis and a gestural quality that shows a degree of consistency across performers and performances. This example demonstrates that specific gestural qualities are required for a single *svara-gamaka* unit in one *rāga*. However, many such units that should be performed with specific gestural qualities exist in Karnatak *rāga* performance, some of which will be discussed in chapter 7 of this thesis.

It should be noted that such gestural qualities and their patterns of emphasis, attack, release, and change in loudness are linked to the need for certain *svarasthānas* in a *rāga* to be either emphasised or de-emphasised. De-emphasis and emphasis of the various *svaras* is part of what conveys the character of each *rāga*, a fact that is acknowledged in Karnatak music theory; for example, Deva (1973) writes of *rāga* grammar that 'Certain *svaras* in [each *rāga's*] alphabet find emphasis to varying degrees' (p. 12). Emphasis and de-emphasis is achieved in practice through the motifs used to perform *svaras*, comprising pitch movement and rhythm, as well as qualities of attack, release, and change in loudness and timbre. For example, in Śaṅkarābharaṇam, *madhyama* should be de-emphasised, or rather the *svarasthāna* that *madhyama* refers to in this *rāga* should be heard only very lightly. Therefore, a variety of *gamakas* are used to perform the *svara*, including a rapid and narrow oscillation between *gāndhāra* and *madhyama*, a wider and slower oscillation between *gāndhāra* and *pañcama*, and on descending phrases the motif *pa-ga-ma* in which *madhyama* is held only briefly. The last two of these forms of *madhyama* can be heard in Media File 2.5 from 0'02" to 0'03", and at 0'19" respectively, in which TKV demonstrates the 'scale' of Śaṅkarābharaṇam to a student. Musical qualities such as attack, release, and change in loudness can be used to further emphasise or de-emphasise the *svara* in such contexts; for example, the motif often used to play *madhyama* in descending phrases (*pa-ga-ma*) should be played with an emphasis on *pañcama* and a reduction in loudness just before *madhyama* is touched. Thus, the gestural qualities of *svara-gamaka* units are connected to the imperative to emphasise or de-emphasise particular *svarasthānas*. However, even if the de-emphasis of certain *svarasthānas* is seen as the primary driving force behind the oscillations, slides, and passing notes that are characteristic of the Karnatak style, this does not detract from the role played by such features and their associated gestural qualities in the aesthetics of the Karnatak style.

Although I have referred to patterns of musical qualities such as emphasis, dynamics, attack, and release as 'gestural', they are also part of the wider expression of musical motion

(see section 1.5). As will be discussed in chapter 7 of this thesis, the motions conveyed through musical motifs sometimes appear to be more typical of objects than of the human body. For example, in Fatone et al. (2011), a Hindustani vocal teacher uses the verbal imagery of a bouncing ball to describe the type of musical movement required in a phrase (2011, p. 209). Such rebound motions, which seem to express the movement of elastic objects subject to manipulation, are also commonly expressed through Karnatak *svara-gamaka* units, including the *gamaka* on *riṣabha* described above which rebounds up to *gāndhāra* before descending to *ṣaḍja*. However, although such motions are perhaps more typical of elastic objects under the manipulation of external forces than to the self-generated motion of the human body, once such motions are expressed through the body movements of the performer (both vocal and manual) they have also become gestures and so may reasonably be referred to as such.

To summarise, in this chapter I have contrasted theoretical and practical conceptions of Karnatak music, before proposing the structural and aesthetic significance of *svara-gamaka* units and motifs formed from sequences of such units, which, while being significant from a performer's perspective, are rarely discussed in music theory due to their multiple forms and context dependent nature. Motifs formed from sequences of *svara-gamaka* units are considered here as 'gestural-sonic objects', holistically perceived chunks of music in which atom events are subsumed under the physical gestures that create them (Godøy 2011, p. 67). This chapter has also provided initial evidence that in order to express the character of a *rāga* correctly, some *svara-gamaka* units are required to be performed with specific gestural qualities, conveyed through patterns of musical features such as emphasis, attack, release, and change in loudness and timbre. The gestural qualities of *svara-gamaka* units and the longer motifs of which they form a part will be discussed further in chapter 7 of this thesis.

In the chapter that follows, I will examine gesture in Karnatak music structure from another perspective, considering the dynamic processes that form the style through a joint musical and motoric analysis of a short section of violin *rāga ālāpana*.

3 Coarticulation and Gesture

3.1 Introduction

This chapter presents an analysis of small-scale melodic movement in Karnatak music, focussing on the musical form known as *rāga ālāpana*, a type of improvisation without metre. A short section of such improvisation will be analysed here from a novel perspective, employing the concept of coarticulation, a phenomenon more commonly discussed in the field of phonetics where it is defined as the variation that a speech sound undergoes when influenced by neighbouring sounds (Hardcastle and Hewlett 1999, p. i). Following from this definition, the aim of the present study is to account for variations in the performance of *svaras* through *gamakas*, by looking at the influence of context on the realisation of musical units. This analysis focuses more on coarticulation in the music itself than in the movements that create it; but since the two are closely related, some analysis of the physical motion of sound-producing gestures is included here.

In the previous chapter, I explained the way in which *svara* and *gamaka* are intertwined in practice, and proposed the *svara-gamaka* unit and motifs formed from short sequences of such units as being significant from a performance perspective and fundamental to the structure of the Karnatak style. In addition, I observed that the categorisation of *gamakas* according to a small numbers of types, without regard to *rāga* context, although prevalent in music theory is almost entirely absent in musical practice and pedagogy. In the analysis that follows, therefore, I seek to provide an account of melodic movement in the Karnatak style at the level of *svara-gamaka* units and the longer motifs made up from chains of such units, drawing more from musical practice than from music theory and focusing on the dynamic processes that form the style rather than categorisation of discrete elements.

My enquiry finds an apt analogy in Kühnert and Nolan's insight regarding the presence of coarticulation in handwriting. They note that the tail of a 'y' is drawn differently depending on its context, remaining open when written at the end of a word and closed with a loop if followed by another letter (1999, p. 9). I suggest that, just as handwriting can be conceptualised as the trace of human movement on paper, so can music be thought of as the trace of human movement through sound. Here I shall ask whether *svaras*, one of the basic conceptual units of Karnatak music, similarly vary in the way they are rendered during performance due to the influence of their immediate context.

While there has been no previous analysis of *svaras* and *gamakas* using such an approach, various authors have pointed towards the significance of context in determining the performance of *gamakas*. Swift (1990) states that the contours of *gamakas* 'vary from one

context to another, depending on the preceding and succeeding *svara*(s)' (p. 72). Here, Swift draws on a quote from Rangaramanujar Ayyangar (1972), who explains the role played by *gamakas* in forming relationships between *svaras*.

> The moment a Gamaka clothes the Swarasthana, the latter is quickened into life. For the Gamaka builds up a relationship with neighbouring members of the family to the right and to the left. (Rangaramanujar Ayyangar 1972, p. 148)

The significance of context on the form taken by *gamakas* that are used to perform *svaras* is also emphasised by Ramanathan (2004), who refers to the 'contextual determination of the shape of a svara' (p. 14). Considering such statements, coarticulation, which deals with variation in the realisation of units depending on their context, appears to be a suitable concept for the analysis of *svaras* and *gamakas* as they appear in musical practice. Just as coarticulation in phonetics is the analysis of phonemes as they are spoken, this will be an analysis of *svaras* as they are realised by *gamakas* in performance.

3.2 Coarticulation

In the field of phonetics, research into coarticulation was prompted by the observation that a phonological segment is not realised identically in all contexts, but rather varies according to the influence of neighbouring sounds (Kühnert and Nolan 1999, p. 7). For example, the articulation of a phoneme may be influenced by the vowel that follows it:

> The English phoneme /k/, for instance, will be articulated further forward on the palate before a front vowel ([kiː] 'key') and further back before a back vowel ([kɔː] 'caw'); and will have a lip position influenced by the following vowel (in particular, with some rounding before the rounded vowel in [kɔː] 'caw'). (Kühnert and Nolan 1999, p. 7)

While coarticulation is an important area of study in phonetics, where it has a long research history (see Farnetani and Recasens 2010 for an overview), studies of coarticulation in human movement are relatively uncommon. For coarticulation to exist, there must first be discrete, conceptually invariant units that subsequently show variation in performance (Kühnert and Nolan 1999, p. 7). In phonetics this unit is the phonological segment, but most examples of human movement are not comprised of conceptually discrete elements. However, phenomena such as sign language and music do consist of such units, making the study of coarticulation possible in these cases. For example, in their study of fingerspelling in American sign

language, Jerde et al. (2003, 2006) define coarticulation as the influence of surrounding movements on the posture of individual units within sequences (2006 p. 82), and find that hand postures used to spell a letter contain significant information regarding preceding and following letters (p. 83). Meanwhile, other studies of sign language have focused on detecting and modelling coarticulation in this context (for example, Yang and Sarkar 2006; Segouat 2009).

A relatively small number of studies have explored coarticulation in musicians' sound-producing gestures. Engel et al. find evidence of anticipatory modifications in pianists' hand movements (1997, p. 198) while Wiesendanger et al. (2006, pp. 114-115) note anticipatory mechanisms at work in violin fingering. In addition, an examination of muscle activity during piano performances by Winges et al. (2013) finds evidence of neuromuscular coarticulation within hand-movement sequences (p. 230).

While these music-based studies observe coarticulation in sound-producing movements, Godøy (2011) has explored the perceptual results of such physical coarticulation in addition to examining the processes involved in its production (Godøy et al. 2010). His definition of coarticulation as 'the fusion of otherwise distinct events, meaning both action events and sound events, into larger and holistically perceived chunks' (Godøy et al. 2009, p. 1) contrasts with definitions employed in phonetics which, as we have seen, more usually refer to variations in the performance of a unit dependent on context. However, both approaches refer to the same phenomenon, one from a production perspective, the other focusing more on perception. Following from this approach, Godøy (2011) coins the term 'contextual smearing' to describe the blurring of borders between 'atom events' such as individual notes, resulting from physical coarticulation. Such contextual smearing may lead larger chunks to be perceived as fused units, referred to by Godøy as 'gestural-sonic objects' (2011, pp. 73 and 68).

Further to his discussion of coarticulation in music, Godøy suggests that such gestural-sonic objects should be regarded as 'primordial' to 'atom events' such as individual tones (2011, p. 71). This proposal leads to a discussion of whether gestural-sonic objects are formed from sequences of discrete units subject to coarticulation, or whether instead gestural-sonic objects should be considered as basic musical units that have over the course of time been split into atom events such as individual notes (2011, p. 72). In Karnatak music, *svaras* as they exist in practice, expressed through *gamakas* and connected in sequences known as *sañcāras* (characteristic phrases), could be described as gestural-sonic objects, while *svaras* as they exist in theory, without ornament and divorced from characteristic phrases, could be viewed as atom events. Interviews with Karnatak musicians conducted during the course of my research indicate they consider all three concepts, *svara, gamaka*, and *sañcāra*, to be essential for successful performance and teaching of the style. Therefore, in this chapter,

rather than claiming either an atomistic or gestural approach to be more significant than the other, I aim instead to explore the relationship between the two.

3.3 Performance and analytical method

The video analysed here was recorded in Srirangam, Tamil Nadu in September 2011 and shows the violinist T.V. Ramanujacharlu (hereafter TKV) a senior performer and top graded artist at All India Radio, performing *ālāpana* in *rāga* Toḍi. The recital took place in the musician's home, and was made specifically for the purpose of this research in order to afford optimum conditions for video and sound recording. As a respected professional performer, TKV's rendering here can be seen as typical of the Karnatak style, which although allowing subtle variations between performers is bound by a complex system of conventions.

The analysis that follows is formed from a joint examination of melodic and physical movement in the particular performance. The kinetic data used in this study is the tracked position of the violinist's left hand as it moves up and down the fingerboard, derived through video tracking.[11] The video was recorded at 24 frames per second, and framed to show a close-up of the violinist's left hand on the fingerboard (see Figure 3.1).

Figure 3.1: A single frame from the video image analysed in this study. Karnatak violin is played with the scroll resting on the violinist's foot. During oscillations the fingers are often held tightly together, and tend to move as one unit.

In Karnatak music the violinist sits on the floor with the scroll of the violin held against his or

[11] Video recording was used in this case, as although motion-capture recordings would have provided hand position data in three-dimensions, the technology is still rather intrusive, requiring multiple cameras and the placing of markers on the performer's body. Motion-capture was therefore unsuitable for research in which the bulk of the recording took place in musicians' homes in locations spread across South India. In the recordings made for this study, the video camera lens was positioned parallel to the plane of the violinist's left hand motion along the fingerboard to ensure that video tracking would capture kinetic data pertinent to this study.

her foot. The other end of the violin rests either just above or below the performer's collarbone, and is sometimes gripped by the chin for increased stability. The manner in which the violin is held means that the camera, when placed directly in front of the performer, is presented a clear and relatively stable view of the violinist's left hand motion in two dimensions. Once the video recordings had been made, Adobe After Effects motion graphics software was used to track the position of the first finger of the violinist's left hand. Karnatak violin technique differs from the Western classical style in that for much of the time the fingers of the left hand are held tightly together. This hand position is used particularly when performing the oscillations that are characteristic of the Karnatak style. When an oscillation is executed, the entire hand usually moves back and forth as one unit. Therefore, by tracking the position of the first finger the resulting data can be used to create visual representations of the left hand's motion trajectory during oscillations.

The opening 39 seconds of the violinist's performance were parsed into phrases of between two and five seconds. Choices for phrase divisions were based on both sonic and kinetic parameters; the recording was split at points where there was either a sonic gap or lack of hand movement for more than one second. A single phrase in which there were no such breaks for over five seconds was divided into two sub-phrases, cut at the point where the hand was motionless for the longest period. This parsing process resulted in the creation of seven phrases for analysis.

The audio files of these phrases were imported into Praat sound analysis software (Boersma and Weenink 2012), in which graphs plotting pitch against time were produced. Composite figures were then created, with transcriptions into both Indian *sargam* and Western staff notation. The transcriptions and pitch contour graphs together with descriptions of the violinist's hand movements and figures showing the tracked hand positions are presented and discussed in the following analysis of coarticulation in small-scale melodic movement.

3.4 Notes on the transcriptions and figures

The *sargam* notation provided here was written in collaboration with the performer, TKV, while I created the staff notation alone through repeated listening to the recording. The aim of the transcription into staff notation was to present a detailed picture of the perceptually salient pitch points in the *svara-gamaka* units. Observing the relationship between the pitch-contour graphs and transcription into staff notation, it can be seen that where the graph shows a continuous oscillation or slide, I have transcribed those pitches that lie at the outer edges of the melodic movement. This is because when listening to the recording these are the most perceptually salient events. Although the sliding or smearing between pitches can be heard in

the recording, the pitch events at the outer edges of the oscillations and leaps are more prominent than the sliding in between. The outer edges of the oscillations are also the salient points for instrumentalists, as their fingers should land at these pitch points, to within a certain degree of tolerance, for the rendition to be considered acceptable.

I have avoided using accidental symbols or arrows in the staff notation transcription to indicate intervals slightly larger or smaller than a semitone, as this would result in a bewildering profusion of such marks. Instead, the subtle details of pitch can be viewed in the pitch-contour graphs. In addition it will be seen that I have not added lines to indicate slides between pitches touched at the extremes of oscillations, as the abundance of such marks would make the transcription rather unclear. Instead, the reader should note that all oscillations seen in the transcriptions are joined by a sonic sliding or smearing effect, as the violinist performs such oscillations using a combination of sliding and rocking motions in the left hand.

Regarding the transposition, in Karnatak music *ṣaḍja* (the tonic) is placed at whichever pitch the soloist finds most comfortable. For female vocalists, *ṣaḍja* is usually placed between G3 (196Hz) and A3 (220Hz), and for male vocalists it is typically set between B2 (124Hz) and C♯3 (139Hz). When accompanying a vocalist, the violinist tunes to accommodate the soloist's preferred pitch, but played an octave higher. Violin solos, however, are usually performed with *ṣaḍja* at D♯4 or E4 (311 or 330 Hz), and in the performance analysed here, *ṣaḍja* was placed at D♯4. The transcriptions that appear in this analysis have been transposed to place *ṣaḍja* at A4, to bring Western classical and Karnatak violin fingerings into alignment.[12] This should make it easier for Western violinists to relate the transcriptions to their own fingering patterns.

The figures showing left-hand movement (for example, Figure 3.6) display the position of the first finger of the violinist's left hand, with each data point representing one frame of the video from which the finger's position was tracked. The position of the first finger provides a good reference for the overall movement of the hand, due to the previously noted tendency for the hand to move up and down the string as a unit in Karnatak violin technique. However, in addition to this motion, there is often a rocking movement articulated at the wrist, during which time the second, third, and fourth fingers may also touch the string or even reach out to sound a much higher pitch. Therefore, the hand motion graph does not map directly on to pitch, as it does not take into account the movement of the other fingers. It

[12] In Karnatak violin the second string is tuned to *ṣaḍja*, which means that by transposing the performance to A, the fingering is brought into alignment with that of the Western classical violin.

simply shows the first finger position, and reflects the motion of the hand as a whole, which is pertinent to the analysis undertaken here.

The shaded areas in the hand motion figures give an approximate indication of the *svara* being played at each point of the movement. These are separated by white spaces of one frame in length to aid legibility. Spaces longer than one frame indicate silence. However, these graphic elements are for guidance only, as the very phenomenon explored in this chapter, coarticulation between *svaras*, makes it difficult to state precisely where one *svara* ends and another begins.

3.5 *Rāga* Toḍi

Here I will build a picture of *rāga* Toḍi as it exists in theory and in practice, before moving on to the analysis of the *rāga ālāpana* performance. A transcription of the theoretical pitch positions of the *svaras* in *rāga* Toḍi is given in Figure 3.2.

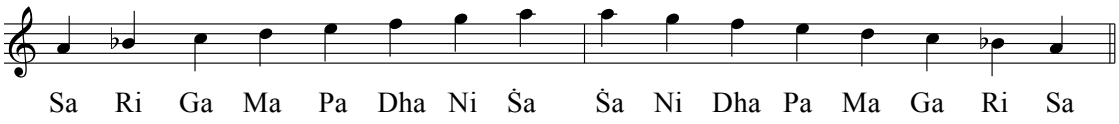

Figure 3.2: The theoretical pitch positions in the *ārohaṇa* and *avarohaṇa* (ascending and descending scale progression) of *rāga* Toḍi transcribed into staff notation with the *svara* names indicated using *sargam* syllables below.

However, an ascending and descending phrase in Toḍi would never be performed with plain notes as shown here (Figure 3.2). All *svaras* in this *rāga*, with the exception of *ṣaḍja* and *pañcama*, should be performed with appropriate *gamakas*, although *madhyama* is frequently performed as a plain note. Figure 3.3 presents a transcription of *gamakas* that may be used to perform the *svaras* of Toḍi, based on a demonstration given by TKV.

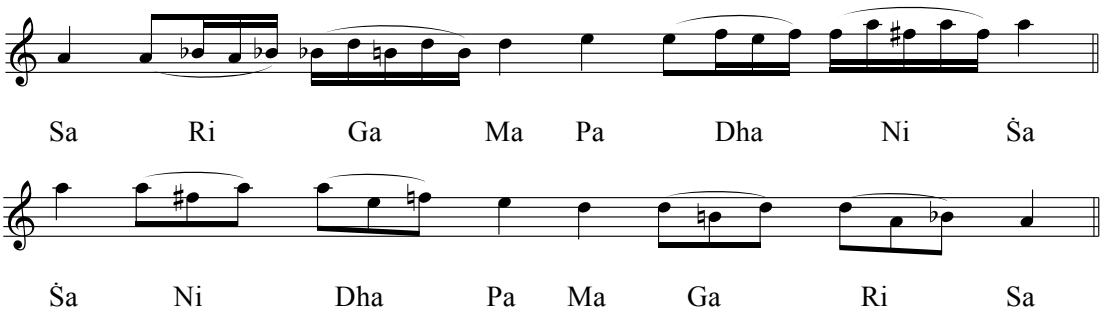

Figure 3.3: A basic rendition of the *ārohaṇa* and *avarohaṇa* (ascending and descending scale progression) in *rāga* Toḍi showing the clusters of pitches that form the *gamakas* on each *svara.* This transcription is from a demonstration given by TKV recorded in Srirangam in September 2011.

The outline in Figure 3.3 is typical of what a teacher might play to a beginner when introducing them to the *rāga*. As can be seen in this transcription, the majority of *svaras* are performed using *gamakas*, constituting small units of melodic movement on and between *svaras*. The analysis that follows will show that the way a *svara* is played varies greatly depending on its context, and it is these variations that I will be examining for evidence of coarticulation.

The transcriptions in Figures 3.2 and 3.3 provide only an approximation of the actual pitches touched in Toḍi, as intervals less than a semitone are conventionally played in this *rāga* (see discussion in section 2.4). Several examples of intervals smaller than a semitone can be seen in the pitch contour graphs accompanying the analysis that follows. For example, the highest point of the oscillation forming *riṣabha* is often placed less than a semitone up from *ṣaḍja* (see Fig. 5).

Looking at Figure 3.3 it can be seen that the pitches transcribed, which lie at the outer edges of the oscillating *gamakas*, include two that are foreign to the *rāga* scale shown in Figure 3.2: B♮ and F♯. These two pitches, although not present in the *rāga* scale, are standardised across performers and performances as being the correct lower pitch in the rendition of oscillations used to express *gāndhāra* and *niṣāda* respectively; all teachers observed during my research have imparted Toḍi in this way. This information is rarely given in books of music theory, and even in music lessons certain teachers may prefer not to explicitly name those pitch positions that lie outside of the *rāga* scale. However, through repeated demonstration and correction teachers ensure that their students understand that the oscillating *gamakas* for *gāndhāra* and *niṣāda* should employ these pitches. As we shall see in the analysis that follows, B♮ and F♯ appear frequently when these two *svaras* are performed. However, in addition to these two frequently occurring foreign pitches, we shall see several others that are not standardised across performers and performances in the same way. The presence of such divergent pitches, I would suggest, is sometimes due to a certain degree of tolerance in the style towards variance in pitches touched at the outer extremes of *gamakas* that are particularly rapid, or otherwise indistinct.

3.6 Analysis

The opening section of *rāga ālāpana* performed by TKV has been transcribed in full in Figure 3.4 (see Media File 3.1, https://youtu.be/ZxfbshHeMVc).

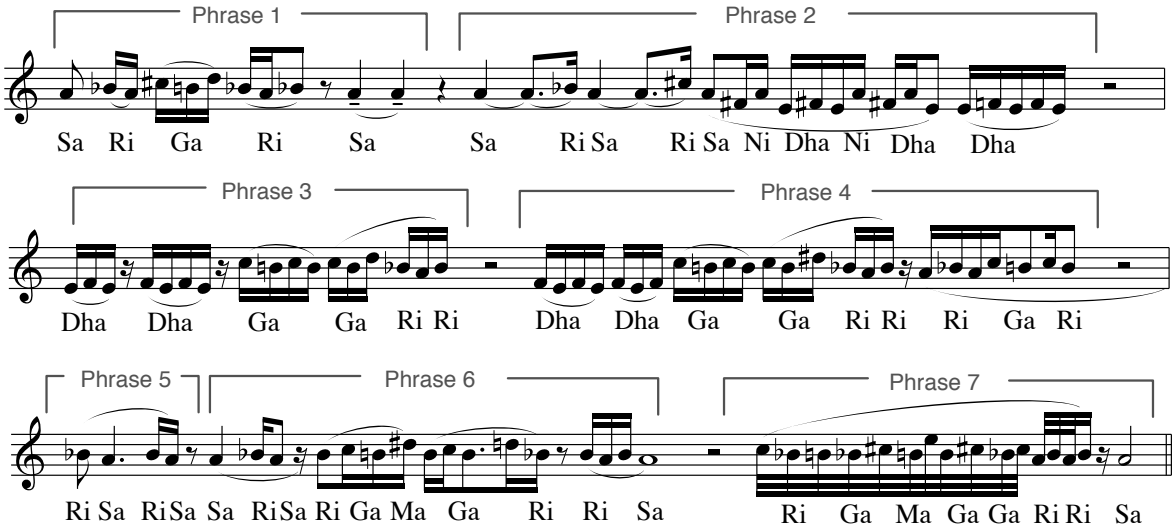

Figure 3.4: The opening thirty-nine seconds of Toḍi *rāga ālāpana*, performed by TKV in Srirangam, Tamil Nadu in September 2011. The transcription into staff notation is a representation of the prominent pitches touched during *gamakas*. The *svaras* are indicated as *sargam* syllables below the staff notation.

The analysis of this section of *rāga ālāpana* that follows will treat each of the seven phrases within this opening section individually, examining context dependent variation in the performance of *svaras*.

Phrase 1

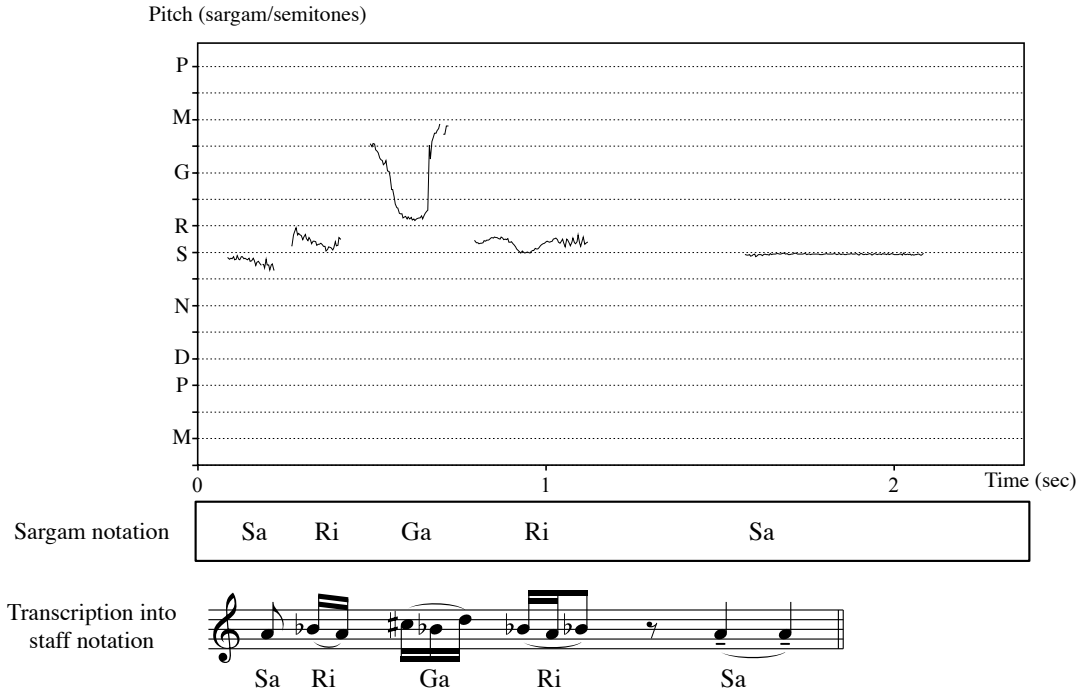

Figure 3.5: Toḍi *rāga ālāpana*, phrase 1: a composite figure showing pitch contour graph, *sargam* notation, and transcription into staff notation for the phrase *sa-ri-ga-ri-sa*.

The opening section of the performance (Figure 3.5) comprises five *svaras*, forming a characteristic phrase that is often used to open *ālāpana* in this *rāga* (see Media File 3.2, https://youtu.be/4WI4x2JxPv8). *Ṣaḍja* is played without *gamaka*, as is usually the case in Karnatak music. The other three *svaras*, comprising the sequence *ri-ga-ri*, are performed with *gamakas* appropriate to the *rāga*. The pitch contour graph in Figure 3.5 concurs with the *sargam* notation, showing five separate sonic events, each played with a separate stroke of the bow. In addition, this graph shows the *glissandi* that occur between pitches, created by the violinist through a combination of sliding and rocking motions in the left hand.

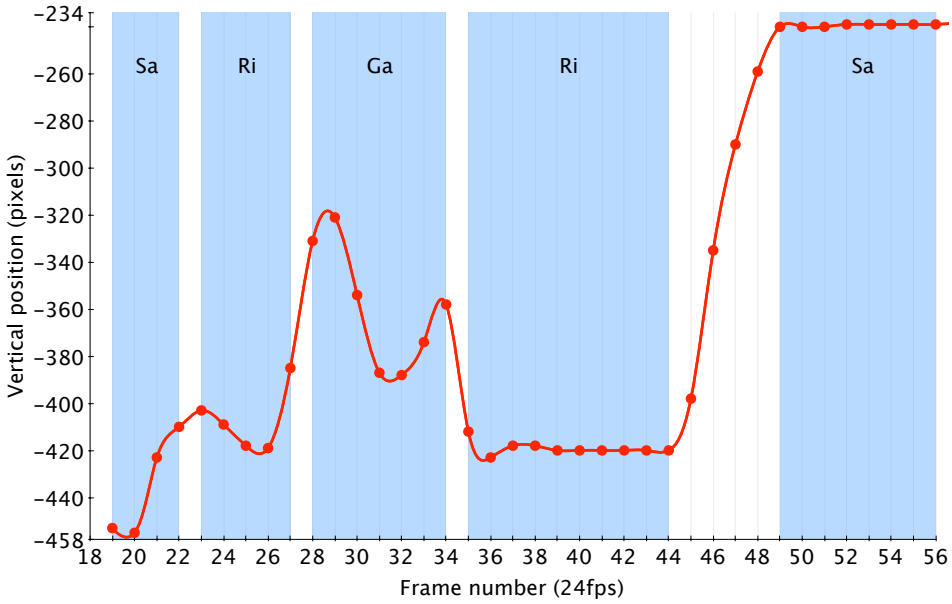

Figure 3.6: The tracked vertical position of the first finger as the entire left hand oscillates back and forth to create the *svaras sa-ri-ga-ri-sa*, in phrase 1. The final *sa* is at a high vertical position due to being played with the first finger on the third string. The shaded areas provide a guide to the *svaras* being played at each stage of the motion.

A visualisation of the sound-producing gestures can be seen in Figure 3.6, in which the tracked vertical position of the violinist's first finger is given. Inspection of this figure reveals that the finger approaches the first *riṣabha* from above, playing the *svara* with a motion trajectory that travels down the string towards the violin nut.[13] This downward force acts as impetus for the oscillation that follows, taking the hand back and forth three times and ending with a narrow oscillation between B♭ and A to create the last *riṣabha*. While the sequence *ri-ga-ri* sounds as though it might be created from three separate hand movements, the position data in Figure 3.6 shows instead that the left hand motion for the sequence comprises one

[13] The downward hand movement referred to here is away from the bridge and towards the violin nut. This is also a movement towards the ground as the violin is held almost vertically with the scroll resting on the performer's heal.

continuous oscillation; the sound is broken by the bow changes while the left hand continues to move. As we shall see in the course of this analysis, the subsuming of several *svaras* within one oscillating melodic and physical movement is common in the Karnatak style, leading to the creation of coarticulatory effects as the performance of each *svara* in the phrase tends to be influenced by the performance of those that precede and follow it.

Although the theoretical pitch position for *gāndhāra* in *rāga* Toḍi is C♮, this pitch is not held at any point in the phrase. Instead the *svara* is expressed through the oscillation that touches C♯, B♭ and D at its outer extremes. This is only one of several ways that *gāndhāra* may traditionally be performed in Toḍi, and so the question arises, why is this particular combination of pitches used here? Further phrases in the performance will be analysed before an attempt is made to answer this question.

Phrase 2

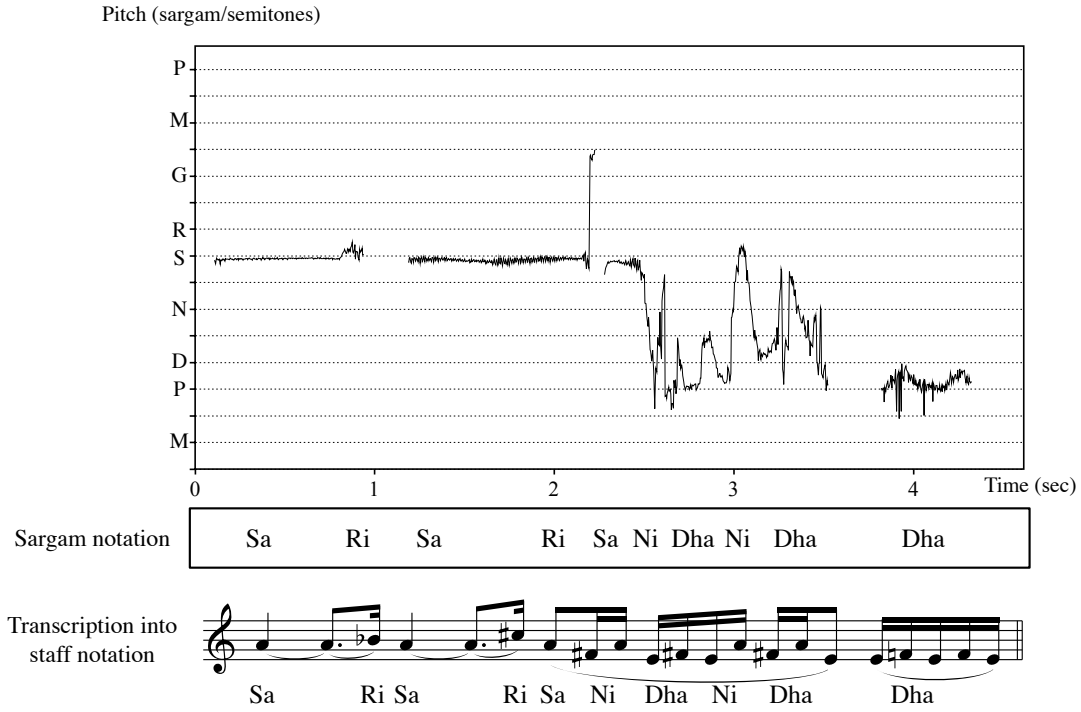

Figure 3.7: Toḍi *rāga ālāpana*, phrase 2: a composite figure showing pitch contour graph, *sargam* notation, and transcription into staff notation.

The opening section of phrase 2, *sa-ri-sa-ri*, is played on the third string of the violin, with each *riṣabha* created by a light flick of the finger up onto a higher pitch (see Media File 3.3, https://youtu.be/EZ2fZWxgoRY). The pitch contour graph (Figure 3.7) shows that the second *riṣabha* is played at a higher pitch than the first: C♯ instead of B♭. However, the *svara* is still named *riṣabha* (interview with TKV, July 2012). In fact, the actual pitch is touched so fleetingly it can hardly be heard, but it leaves a sonic impression that is considered desirable

by some performers in this particular context.[14]

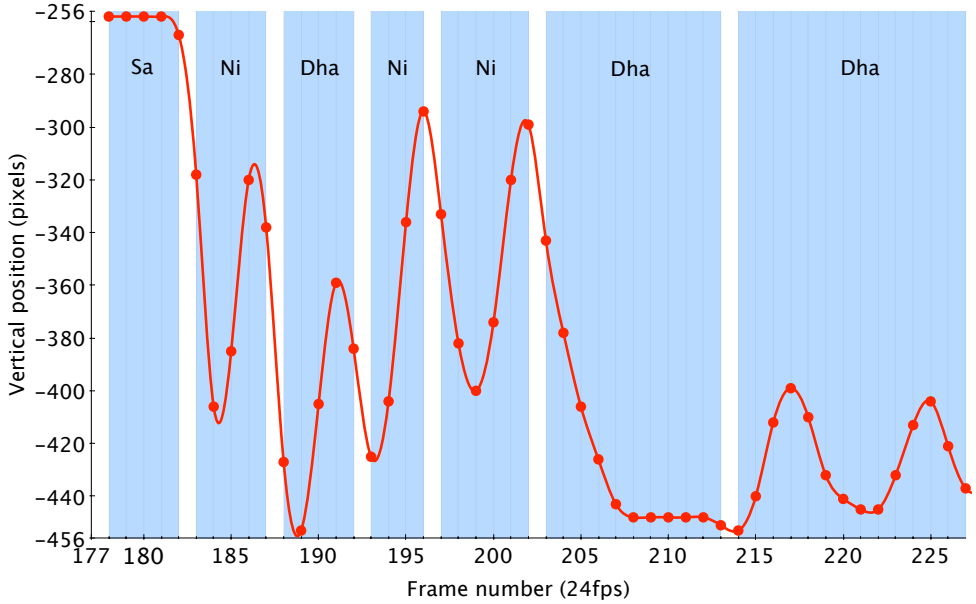

Figure 3.8: The tracked vertical position of the first finger as the entire left hand oscillates back and forth to create the *svara* sequence *sa-ni-dha-ni-dha-dha* in phrase 2. The shaded areas provide a guide to the *svaras* being played at each stage of the motion.

The second part of phrase 2, *sa-ni-dha-ni-dha*, is played with one continuous motion of the left hand (see Figure 3.8). This movement consists of four and a half oscillations, each one describing a *svara* in the sequence, *ni-dha-ni-dha,* with one and a half oscillations used for the final *dhaivata*. It can be noted that the last two renditions of *dhaivata* in phrase 2 differ (see Figure 3.9). The first is played as a movement starting from the A that formed the end of *niṣāda*, oscillating back and forth touching F♯–A–E, while the *dhaivata* that follows consists of an oscillation between E and F♮. This is a good example of the way in which different musical contexts influence the performance of the same *svara*. The *gamaka* used to play the first *dhaivata* allows the oscillation initiated in the *svaras* before it to continue. There are other ways of performing *dhaivata* in Toḍi, but the one chosen here creates flow through the extension of a musical and physical motion initiated in the previous *svaras*. In this case, the influence of the preceding oscillation on the performance of *dhaivata* can be viewed as an example of coarticulation, wherein the performance of a unit is influenced by that which precedes or follows it. *Dhaivata* here is subsumed under the musical and physical motion that precedes it.

[14] Similar motifs in which *ṣaḍja* is broken by a lightly touched high-pitched *riṣabha* can also be found in *ālāpanas* in *rāga* Toḍi performed by the renowned violinist M.S. Gopalakrishnan.

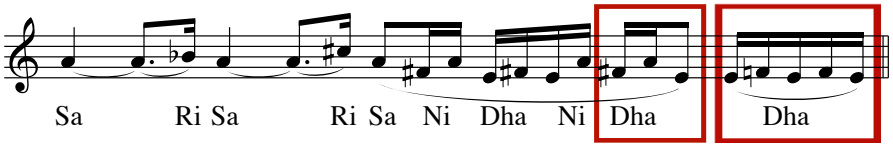

Figure 3.9: Variation in the performance of *dhaivata* at the end of phrase 2.

The last *dhaivata* in phrase 2 differs substantially from the one that precedes it (see Figure 3.9), consisting of an oscillation between E and F♮. This is the form of *dhaivata* often used in Toḍi when the *svara* is played alone or ascends from *pañcama* as in the demonstration in Figure 3.9. Musical conventions relating to context mean that it may not be performed in the same way as the previous *dhaivata* (F♯–A–E), as that motif would only be used to perform the *svara* during descending phrases subsumed under an oscillatory movement. In this way the performance of each *dhaivata* here is influenced greatly by its immediate context.

Phrase 3

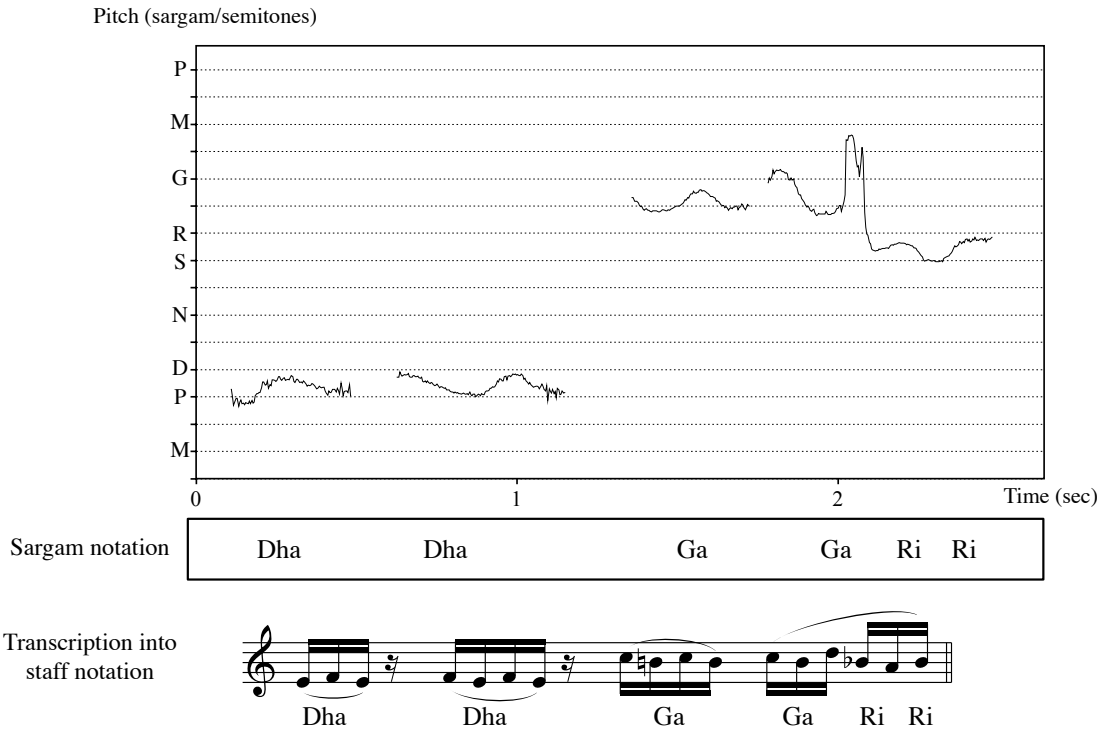

Figure 3.10: Toḍi *rāga ālāpana*, phrase 3: a composite figure showing pitch contour graph, *sargam* notation, and transcription into staff notation.

Inspection of Figures 3.10 and 3.11 reveals that phrase 3 consists of two sub-gestures: the opening *svaras*, *dha-dha*, are played with one continuous oscillation of the left hand, while the following sequence, *ga-ga-ri-ri*, is formed from a second oscillatory motion played on the next string (see Media File 3.4, https://youtu.be/Dfcl3sSGJ2o). In the opening gesture, the two *svaras*, *dha-dha*, are the same but the pitch patterning of each differs: E–F♮–E in the first

dhaivata and F♮–E–F♮–E in the second. The hand motion used to perform the second *dhaivata* flows smoothly from the movement employed for the previous *svara*, creating a continuous oscillation. I would suggest the pitch patterning of the second *dhaivata* is determined by the tendency of the Karnatak style to subsume proximal *svaras* within continuous oscillations. Employing this interpretation, the second *dhaivata* starts on F so that the oscillation used to perform the previous *dhaivata* may continue. This, therefore, can be seen as an example of coarticulation between *svaras*, as the movement of the first *dhaivata*, both musical and physical, carries over into the motion of the second.

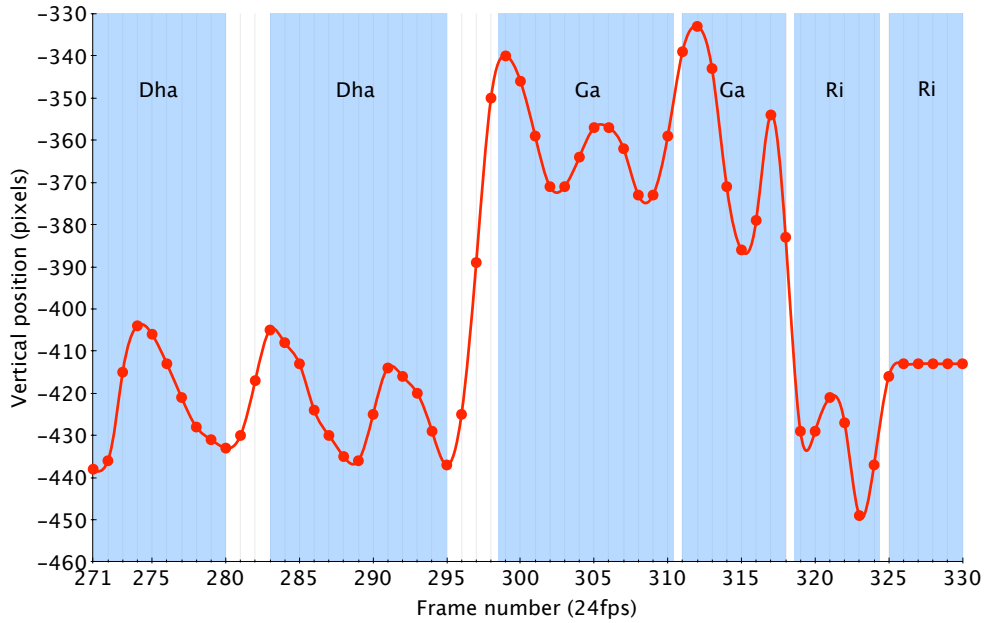

Figure 3.11: The tracked vertical position of the first finger as the entire left hand oscillates back and forth to create the *svaras dha-dha-ga-ga-ri-ri* in phrase 3. The shaded areas provide a guide to the *svaras* being played at each stage of the motion.

In the second part of phrase 3, the first *gāndhāra* gently oscillates between C and B♮, before widening out to form the second *gāndhāra*, performed as C–B♮–D. Finally the hand moves down sharply to create the final *svaras*, *ri-ri* (see Figures 3.10 and 3.11). Here once again there are two *svaras* with the same name, but performed differently due to their context. *Gāndhāra* performed as part of an ascending phrase is normally formed from an oscillation: at this transposition either between B♮ and D, or occasionally if the phrase is rapid and indistinct between B♭ and D, or even B♮ and D♯. However, *gāndhāra* when played alone or before a descending phrase is more likely to be performed as an oscillation between C and B♮. So, once again, the performance of this *svara* is very much dependent on its immediate context.

Phrase 4

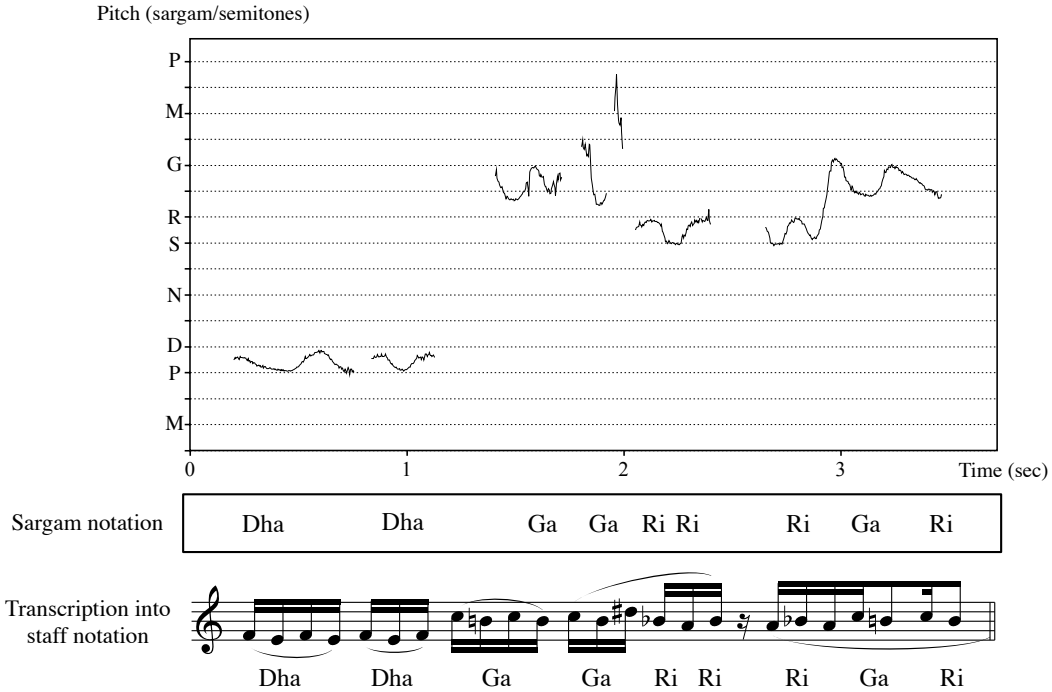

Figure 3.12: Toḍi *rāga ālāpana*, phrase 4: a composite figure showing pitch contour graph, *sargam* notation, and transcription into staff notation.

The opening of phrase 4 (Figure 3.12) is a repetition of the *svaras* played in the previous phrase (see Media File 3.5, https://youtu.be/Nnk9sj761IY). However, their realisation differs subtly, as the first *dhaivata* starts on F♮ rather than E. Although the pitch patterning of the motif *dha-dha* is different in the two phrases, the musical logic of two *svaras* subsumed under one oscillating gesture remains the same (see Figure 3.13).

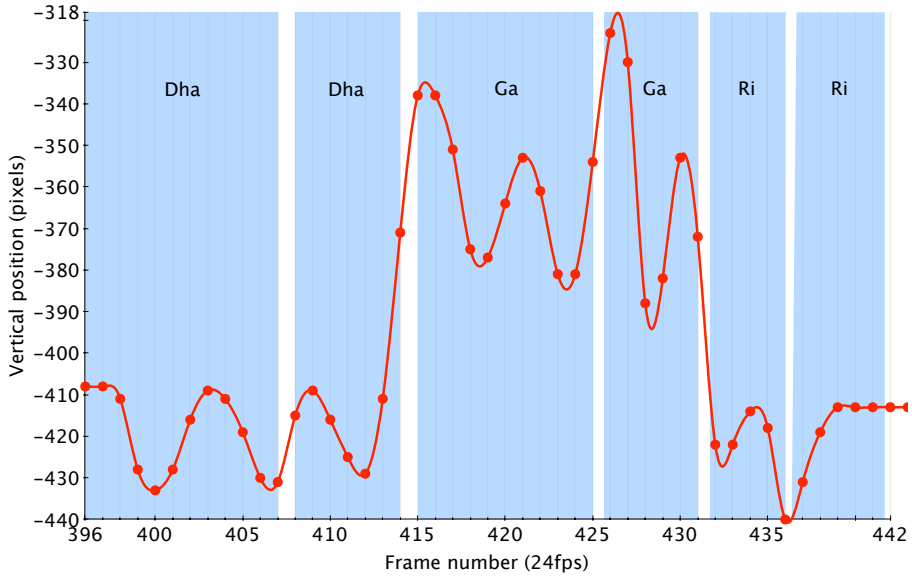

Figure 3.13: The tracked vertical position of the first finger as the entire left hand oscillates back and forth to create the *svara* sequence *dha-dha-ga-ga-ri-ri* in the first part of phrase 4. The shaded areas provide a guide to the *svaras* being played at each stage of the motion.

The final *riṣabha* in this phrase is notable in that it falls only to approximately B♮ rather down to B♭, the pitch theoretically indicated by *riṣabha* in Toḍi. However, this only works here because the violinist takes the pressure off of the bow as the left hand slides down the string, leading to a type of fade-out effect that implies that the hand may still be continuing downwards. If, conversely, the violinist were to emphasise B♮ at this point, it would be unacceptable. In this case we can see the importance of musical emphasis in forming the characteristic phrases of Toḍi. While the pitches touched are significant, the gestural qualities of characteristic motifs are often of equal importance in conveying the *rāga's bhāva*.

Phrase 5

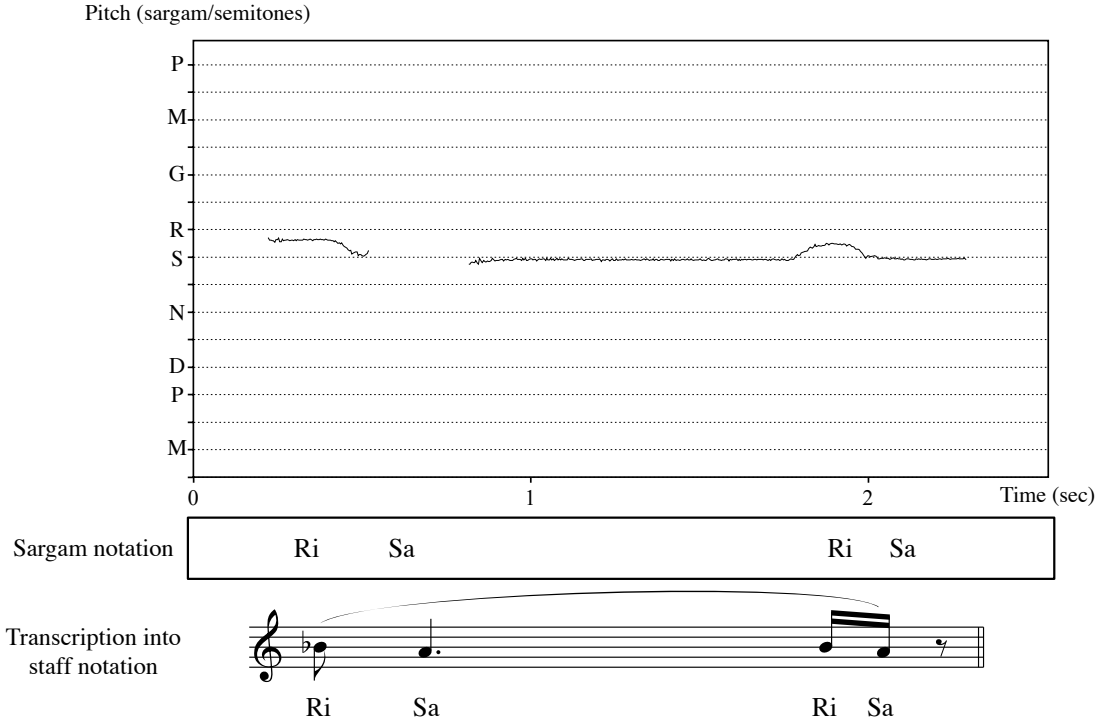

Figure 3.14: Toḍi *rāga ālāpana*, phrase 5: a composite figure showing pitch contour graph, *sargam* notation, and transcription into staff notation.

The slow oscillation between *riṣabha* and *ṣaḍja* in phrase 5 (Figure 3.14) acts as a prelude to the phrase that follows (see Media File 3.6, https://youtu.be/AocWW6DWuIs).

Phrase 6

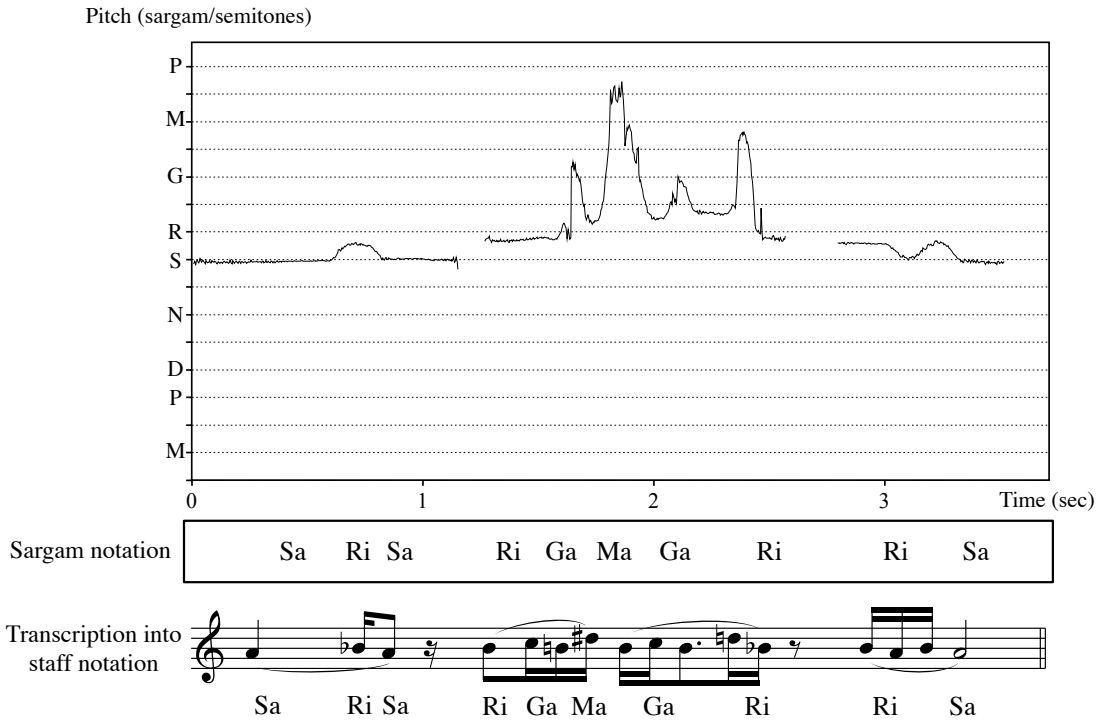

Figure 3.15: Toḍi *rāga ālāpana*, phrase 6: a composite figure showing pitch contour graph, *sargam* notation, and transcription into staff notation.

Phrase 6 (Figure 3.15) consists of three musical gestures (see Media File 3.7, https://youtu.be/m2tKmZ7QM8U). The first conveys *sa-ri-sa* through a subtle touch of the first finger onto B♭ for *riṣabha* before sliding down to the violin nut, leaving *ṣaḍja* played as an open string. In the second gesture an oscillation emerges from *riṣabha*, continuing back and forth one and a half times to form the *svara* sequence *ri-ga-ma*, then plunges back down to B♮ holding for a moment before continuing the oscillation down to a subtle *riṣabha*. In this sub-phrase, the *svaras* are subsumed under a single oscillatory movement (see Figure 3.16), and the *gamaka* used to perform each *svara* starts from the end point of the previous *gamaka*. In this way, as Rangaramanujar Ayyangar explained, the *gamakas* build relationships between the *svaras* (1972, p. 148). It is this tendency to build relationships between *svaras* by linking them that leads to their coarticulation. This coarticulation seen in the second section of phrase 6, *ri-ga-ma-ga-ri* (see Figures 3.15 and 3.16), means that the phrase may be understood as a 'gestural-sonic object' (Godøy 2011) in which the borders between *svaras* have, through the *gamakas* used to perform them, become blurred.

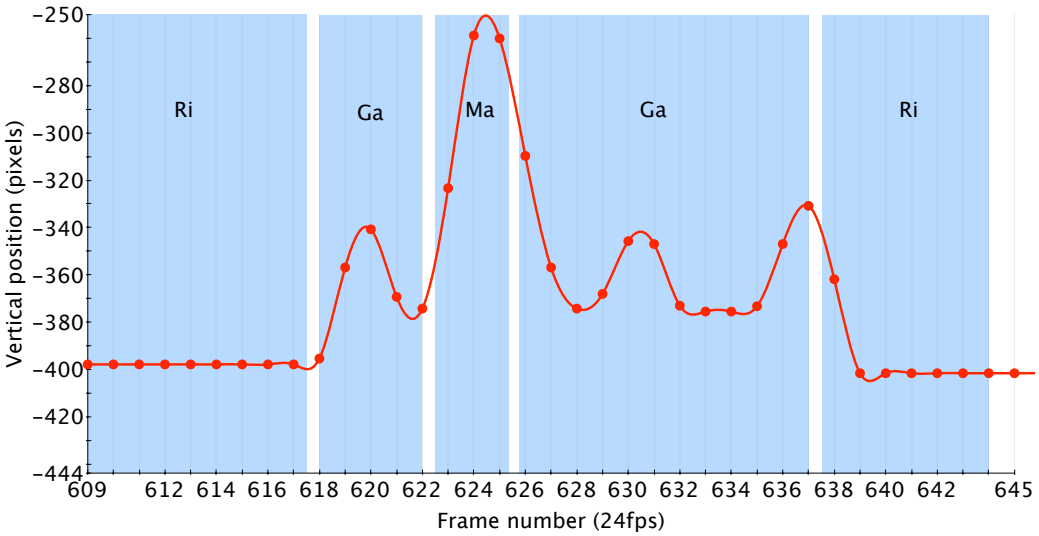

Figure 3.16: The tracked vertical position of the first finger as the entire left hand oscillates back and forth to create the *svaras ri-ga-ma-ga-ri* in phrase 6.

Phrase 7

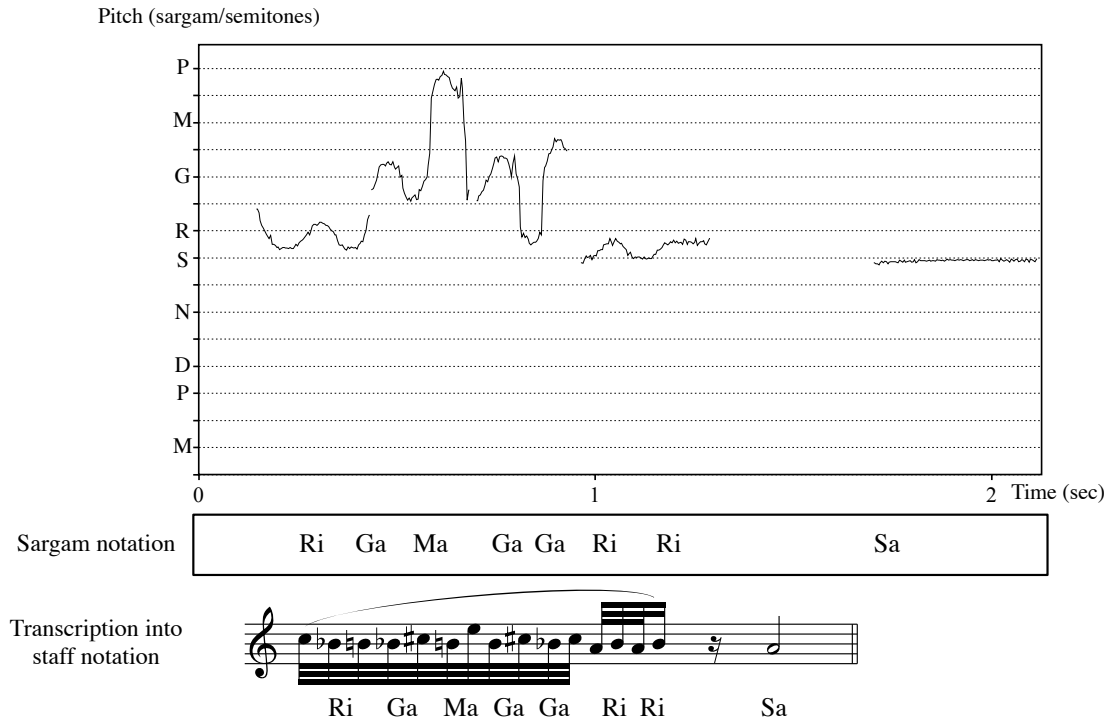

Figure 3.17: Toḍi *rāga ālāpana*, phrase 7: a composite figure showing pitch contour graph, *sargam* notation, and transcription into staff notation.

The final phrase in this analysis (Figure 3.17) is formed from a single extremely rapid oscillatory movement of the left hand that describes the *svaras ri-ga-ma-ga-ga-ri-ri*, followed by *ṣaḍja* on the open string (see Media File 3.8, https://youtu.be/VQPqZfCJmwI). From the transcription and pitch contour graph in Figure 3.17 it can be seen that several of the pitches

touched do not appear among the theoretical pitch positions of *rāga* Toḍi. While the use of B♮ to perform part of the *svara-gamaka* unit that realises *gāndhāra* is standardised in this *rāga*, as discussed earlier in this chapter (see section 3.5), C♯ is not. The sharp *gāndhāra* seen here may, therefore, result from a degree of tolerance in the style towards variance in pitch during rapid or indistinct *gamakas*.

The oscillating hand motion used to create this phrase can be seen in Figure 3.18. Every *svara* in the phrase shows evidence of coarticulation with the one that precedes it, as each *svara-gamaka* unit starts from the point at which the previous *svara-gamaka* unit ends in order that the oscillation may continue throughout. Here, once again, the borders between individual *svaras* are difficult to define due to coarticulation. The *svaras* in this phrase can be described as subject to 'contextual smearing' through the *gamakas* with which they are performed (Godøy 2011).

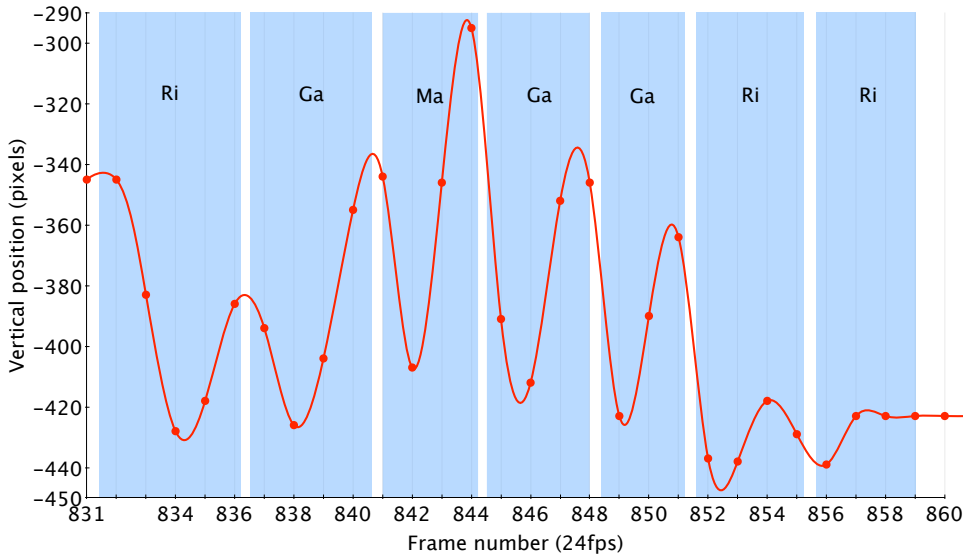

Figure 3.18: The tracked vertical position of the first finger as the entire left hand oscillates back and forth to create the *svaras ri-ga-ma-ga-ga-ri-ri* in phrase 7.

3.7 Discussion of variation in the performance of *gāndhāra*

So far in this analysis, the way that a *svara* is performed has been shown to vary depending on its context. Several of these variations have been identified as exhibiting characteristics of coarticulation; for example, when the *gamaka* used to perform a *svara* starts from the end point of the one that precedes it, or when a *gamaka* continues an oscillatory movement initiated in the preceding sequence. In the following discussion I will explore a single *svara* in more detail, looking at its various manifestations in the phrases examined.

There are ten performances of *gāndhāra* in the first thirty-nine seconds of this *rāga*

ālāpana. The *svara-gamaka* units used to perform each of these is distinct in some respect, if not in pitch then in emphasis. Three of the variations have been highlighted in Figure 3.19, together with a fourth version transcribed from a separate demonstration of the *rāga* scale by the same performer.[15] Looking at the range of variations, there appear to be two broadly defined schemas available for performing *gāndhāra* in Toḍi.[16] One is a wide oscillation as seen in phrase 1 (C♯–B♭–D) and also the *rāga* scale demonstration (B♭–D–B♮–D–B♮); the other is a narrow oscillation between C and B♮, which can be seen in phrases 3, 4, and 6. Within these two schemas for *gāndhāra* there exist a multitude of potential subtle variations in pitch, patterning and emphasis. The remainder of this discussion will consider the factors that determine the form of *gāndhāra* in each of the four phrases shown in Figure 3.19.

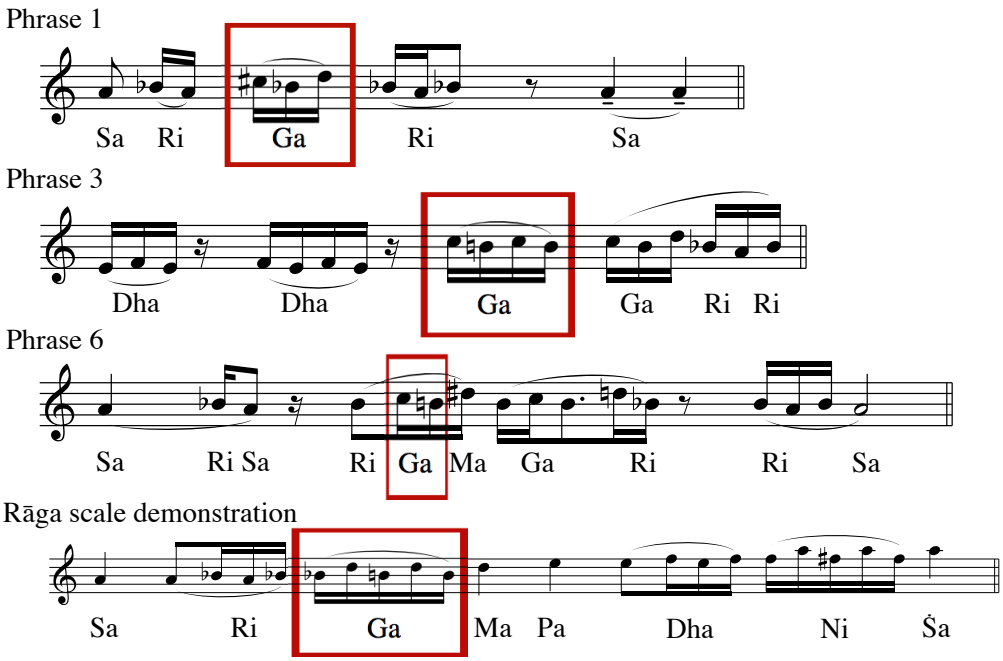

Figure 3.19: Varieties of *gāndhāra* performed in the opening section of Toḍi *rāga ālāpana*, and the *rāga* scale demonstration by the same performer.

In the case of the *rāga* scale demonstration (Figure 3.19, fourth example) *gāndhāra* is preceded by *riṣabha* and followed by *madhyama*, and is played as B♭–D–B♮–D–B♮. Keeping in mind that one of the functions of *gamakas* is to create a fluid movement from one *svara* to the next (TKV, personal interview, Srirangam, June 16, 2012), this performance of *gāndhāra*

[15] It should be noted that the rāga scale demonstration is a special context, existing somewhere between theory and practice. The entire phrase as seen here would not appear in a performance of Toḍi *rāga ālāpana*: phrases more characteristic of the rāga would be used instead. However, it does represent the teacher's authorised version of the *gamakas* used to perform the *svaras* in an ascending and descending context.

[16] See Widdess 2013 for a discussion of schemas in the context of North Indian music.

can be interpreted as starting from B♭ because it is the pitch at which the previous *svara* ends. In addition, the oscillation that follows takes the player neatly back up to the D required to play *madhyama*. This example can therefore be seen as an instance of coarticulation in two directions. If instead, *gāndhāra* was played here as C–B♮–C–B♮ it would fail to join smoothly with either the preceding or following *svara*: it would not make the *svaras* flow, as *gamakas* should (TKV, personal interview, Srirangam, June 16, 2012)).

Although both the *gāndhāra* in phrase 6 and the one that occurs in the *rāga* scale demonstration appear between the *svaras riṣabha* and *madhyama*, the wider phrase differs, as does the speed at which it is played (see Figure 3.19). These factors affect the realisation of the *svara*, and in phrase 6 *gāndhāra* is performed as C– B♮ rather than B♭–D–B♮–D–B♮. However, in both cases the same kinetic rationale is followed, with *gāndhāra* being performed using an oscillation that links *riṣabha* to *madhyama*. In the case of the *gāndhāra* in phrase 6 only a single oscillation is used, as the phrase is faster and therefore allows less time for elaboration.

In phrase 1 (see Figure 3.19), the performance of *gāndhāra* does not, from the transcription alone, seem to show any evidence of coarticulation with the *svaras* preceding or following it: the *gamaka* used to perform *riṣabha* ends on A, and the one used to play *gāndhāra* starts on C♯. However, from the kinetic analysis in Figure 3.6 we can see that the *svaras ri-ga-ri* in middle of this phrase, while sounding like three separate sonic events, are performed using a continuous left hand movement (see Media File 3.2, https://youtu.be/4WI4x2JxPv8). The performance of *gāndhāra* as C♯–B♭–D allows this oscillatory movement to continue through the sequence. Here it is primarily the hand movement that shows evidence of coarticulation; the separate bow articulations used to play the phrase prevent the continuous hand movement from resulting in an uninterrupted sonic oscillation. However, the pitches touched are a direct result of the hand movement that subsumes the phrase, and so coarticulation can be said to occur between *svaras*.

3.8 Wider significance and applications

Coarticulation has been observed in this example of *rāga ālāpana* in the contextual influences exerted on the performance of *svaras*. Much of the coarticulation examined here is created through the oscillatory motions, both musical and physical, that are characteristic of the Karnatak style. As sequences of *svaras* are subsumed under single oscillatory gestures, each *svara* coarticulates with the next through the *gamaka* with which it is performed.

The remainder of this chapter will compare atomistic and gestural perspectives in Karnatak music performance, and the way that coarticulation manifests in each. Finally, I will

conclude with a discussion of the wider implications of coarticulation for musicological research, and the various potential applications of the concept.

3.8.1 Coarticulation in atomistic and gestural conceptions of Karnatak music

The contrast between atomistic and gestural perspectives has been discussed in both this and the previous chapter (see sections 3.2 and 2.1): atomistic in this context being a *svara* based approach, while a gestural perspective functions holistically, focusing on motifs often performed with a continuous physical movement. I will argue here that musicians use both of these perspectives during their training and in performance. In addition, I will discuss how coarticulation manifests in each of the two perspectives.

As discussed in chapter 2, Indian music theory tends to emphasise the atomistic, *svara* based perspective, perhaps because it is easier to notate and standardise. However, Viswanathan states that musicians largely conceive of *rāga ālāpana* through characteristic phrases (*sañcāras*) (1977, p. 38), a view that is supported by musicians' statements made during interviews conducted in the course of my research. The analysis provided in the present chapter has shown that coarticulation is built into the structure of such phrases.

Notwithstanding the significance of characteristic phrases in Karnatak music, patterning of *svaras* with little reference to such phrases does occur both during the learning process and in performance. In fact, a *svara* based perspective is often adopted by musicians. *Svarajnāna* (awareness or knowledge of *svaras*) is considered an essential element of Karnatak musicianship, and at any moment the performer should be able to say exactly which *svaras* are being sung within a phrase. The early stages of the learning process place great emphasis on singing *svaras* using their *sargam* nomenclature (Kassebaum 1987, p. 47). Beginners, both instrumentalists and vocalists, practice elaborate vocal exercises in which patterns of *svaras* performed as plain notes or sometimes with a few *gamakas* are subject to exhaustive permutations. This training must be completed before students move on to learn simple compositions, the stage at which *gamakas* are typically introduced. Therefore, having been taught exercises with *svaras* largely performed as plain notes, they must then learn how to connect the *svaras* through *gamakas*. As a result, the concept and practice of linking *svaras* through *gamakas* is ingrained in performers from an early point in their musical training.

Later, as students learn compositions and *ālāpana* by imitating phrases played or sung by their teacher, *svara* awareness still plays an important role. In the course of my fieldwork I regularly observed that when a student fails to correctly imitate a phrase, the teacher would then repeat it, this time singing the *svara's sargam* nomenclature rather than the lyrics or other syllables. This pedagogic technique frequently resulted in the student singing the phrase without difficulty on their next attempt. In such cases, awareness of which

svaras are being sung appears to trigger memories of how they should be performed in that particular context. Therefore, it seems possible that students, to some extent, retain conceptual models of how each *svara* should be rendered in a particular context in a given *rāga*, without any direct reference to characteristic phrases.

In addition to providing an important pedagogical and phonemic foundation throughout the style, a *svara* based perspective is also prominent in musical forms such as *svara kalpana,* where the performer improvises *svara* patterns which are sung using their *sargam* syllables. In this improvisatory challenge, characteristic phrases, or *sañcāras*, play a lesser role and the manipulation of *svara* patterns dominates.[17]

Given such evidence, I would suggest that although characteristic phrases may be the dominant conceptual mode for Karnatak musicians, a *svara*-based perspective is also present: deliberately formed during the learning process and remaining active in professional performers. When this atomistic or *svara*-based mode dominates, there is also the stylistic imperative to link *svaras* using *gamakas*. In later stages of the learning process, linking occurs without planning or effort; however, earlier on the student may be conscious of the need to create such connections. Although Karnatak performers do not directly refer to the concept of coarticulation using this or any equivalent term, they are very much aware of the need to link *svaras* using *gamakas* (Balu Raghuraman, personal interview, London, 24 July 2012), and it is this linking that leads to coarticulation.

3.8.2 Coarticulation and musicology: implications and applications

From a music analysis perspective, I would characterise the status of coarticulation in musical contexts as similar in many respects to that which it holds in phonetics. Words are not usually learnt by arranging phonetic units and then coarticulating them, rather people learn the vocal gestures to produce words in which coarticulation is already present. However, in phonetics, coarticulation is still considered a useful tool for understanding how a language works and why phonemes take a particular form in a given context. In addition, the concept plays an essential role in modelling language, and also in developing automatic speech recognition (Cohen and Massaro 1993; Lee 1990). In the same way, being aware that individual *svaras* in Karnatak music are subsumed under larger gestural units and are, therefore, subject to coarticulation should help musicologists understand how this particular musical language works, providing insight into why a *svara* is played in a particular way in a given context.

[17] Although it may be argued that many *svara* patterns in this context become 'characteristic' through repetition, there is still great latitude in *svara kalpana* for the creation of innovative *svara* combinations.

An awareness of coarticulatory processes in Karnatak music also allows us to better understand the relationship between *svara*, *gamaka* and *sañcāra* as they exist in practice; for example, it helps to explain why *gamakas* appear in such a variety of forms. While it is certainly reasonable to define *gamakas* as belonging to types such as *kaṁpita* (oscillation), *jāru* (slide) and *janta* (finger stresses) (Powers 1959, p. 147), this is not sufficient information for us to understand how such *gamakas* should be performed. However, what can help us in this endeavour is to know that there is a stylistic tendency to form links between two or more *svaras* and to subsume individual *svaras* under single oscillating gestures. In this way the dynamic processes underlying the style becomes clearer.

I would suggest that coarticulatory theory provides an appropriate way of modelling Karnatak music as it exists in practice, and could potentially assist in the prediction of how a particular *svara* should be played if its immediate context is given. Coarticulation may also be a useful concept for application in the field of music information retrieval (MIR), both in Indian and other musical contexts, similarly to the way in which it is used in speech recognition.[18] Finally, coarticulation is likely to occur in other musical styles, particularly those that are highly ornamented or melismatic, and so these may also be suitable for analysis or modelling with respect to the phenomenon.

3.9 Conclusions to this section of the thesis

In this first section of my thesis I have discussed the role played by physical and musical gesture in the structure and aesthetics of Karnatak music. My interim conclusions are as follows:

- *Svara-gamaka* units and longer motifs formed from sequences of such units underlie the structure of the Karnatak style as well as its aesthetic, contributing greatly to the creation of the *bhāva* particular to each *rāga*. Such units can be described as gestural in that they are formed from the continuous physical movements of musicians. In addition, the traditions of the style often require such units to be performed with particular patterns of emphasis, attack, and release that, according to ecological theories of perception, convey something of the sound-producing gesture to the listener.
- There is a strong tendency in the Karnatak style towards the linking of one *svara* to the next. This linking is achieved through gestures that are at once physical and

[18] Although Godøy and Jensenius (2009) have discussed coarticulation in an article on body movement in music information retrieval, there is to date no published MIR research applying the concept of coarticulation to Indian music contexts.

musical, with oscillatory and sliding motions being key in forming connections between *svaras*.

- The Karnatak style displays evidence of coarticulation, in that the *svara-gamaka* unit used to perform a *svara* depends on its context. In coarticulated sequences, atom events (*svaras* and individual pitches touched) are subsumed under the wider gestural motion to form holistically perceived gestural-sonic chunks.

Having presented this account of gesture in Karnatak melodic structure, in the next section of the thesis I will examine the physical gestures that accompany singing in vocal lessons, in order to consider further the role that gesture plays in the style.

4 Introduction to Part Two: Physical Gestures in Karnatak Vocal Lessons

4.1 Context

While the previous chapters focused on the significance of gesture in Karnatak music structure, here I enquire into the role played by physical gesture in vocal lessons, analysing the relationship between body movement, music, and pedagogic interaction in this setting. During vocal lessons, teachers tend to produce elaborate hand gestures while singing phrases for the student to imitate. Students also gesture during lessons, although not usually to the same extent as teachers. The gestures of teachers and students are spontaneous rather than codified, and in this respect are akin to the hand gestures that accompany speech in everyday conversation. Karnatak co-singing gestures are not explicitly taught or systematically learnt, but rather are acquired through implicit learning over many years of interaction with teachers who produce such gestures.[19] The prevalence of hand gestures in Karnatak pedagogic contexts and their apparent connection to musical features of the phrases with which they co-occur led me to ponder the role they play in the learning process and the ways in which physical movement may index musical qualities, the primary questions posed in this second part of the thesis.

Hand gestures produced by vocal teachers in pedagogic contexts are similar to those arising during concert performances, although, as I will explain later, they are not exactly the same. In this thesis, I have chosen to focus on gestures produced in vocal lessons, primarily because of the influence that the learning process has on the formation and maintenance of musical style. In short, that which repeatedly occurs in lessons is likely to have implications for students' conceptions of the music and the qualities of their performance practices. Neuman (2012) has explored this topic, proposing that the non-classificatory mode of instruction and repetitive nature of practice in traditional Hindustani music pedagogy supports body knowledge, improvisation, and creativity in the style.[20] Following from this proposal, I would suggest that continuous exposure to Karnatak vocal teachers' co-singing gestures during the learning process could influence students' developing conceptions of the style and subsequent performance practices. Therefore, vocal lessons are an important context for the

[19] This statement is based on my observations while learning and researching the style. Similarly, Rahaim notes that the gestures of Hindustani vocalists are not explicitly taught (2012, p. 2).

[20] As discussed in section 2.5 of this thesis, Karnatak teachers similarly tend to place little emphasis on classificatory knowledge regarding *gamakas*, and the exhaustive repetition of *varṇams* (studies) in different *rāgas* is considered essential for the student's musical development.

study of gesture in Karnatak music. My second reason for focusing on gesture in vocal lessons rather than in concert performances is that although there are gestures arising in both contexts that appear linked to melodic motion, many gestures produced in performances are aimed towards forging a connection with the audience and enacting emotions associated with the *rāga* or *sāhitya* (lyrical content). I chose, therefore, to focus on the gestures produced in lessons, which are less affected by such factors.

Although there have been no previous studies of physical gesture in Karnatak music, there have been several exploring gesture in North Indian contexts. Clayton (2005, 2007) examines non-verbal communication in *khyāl* performance; Leante (2009) discusses the relationship between co-singing gestures and kinetic analogies conveyed by music; and Rahaim (2012), who views vocalisation and gesture as parallel aspects of melody (p. 52), explores, amongst other issues, the transmission of gestural disposition through teaching lineages. While the work of these three authors has been influential on the present thesis and will be discussed in the chapters that follow, the approach I employ here differs from that used in previous studies in several respects. In addition to asking distinct research questions about a contrasting musical tradition I employ different methods, including systematic and empirical approaches such as measurement of hand position through video-tracking techniques and coding of gestures using video annotation software. Furthermore, I draw on theories and approaches from the wider field of gesture studies that have not previously been applied to gesture in musical contexts, including work by Alibali and Nathan (2012) on addressee gestures and the creation of common ground. These methods and theories will be discussed at length in the chapters that follow.

A number of music and gesture studies have employed co-speech gesture typologies in their analyses, including Clayton (2007) on *khyāl* performance; Simones et al. (2015) on gesture in piano teaching; and Davidson (2001) on gestures produced in a performance by Annie Lennox. However, in this thesis I will not make use of gesture categories for the following reasons. While early work in the wider field of gesture studies saw a proliferation of gesture typologies (for example, Ekman and Friesen 1969; Rimé and Schiaratura 1991; McNeill 1992) such efforts have more recently been set aside. This is due to a growing awareness that the polysemous nature of gesture, in which a single hand motion typically has numerous functions and meanings, renders categorisation of gesture problematic. McNeill, who in his earlier work created an influential gesture typology, consisting of iconics, metaphorics, beats, cohesives and deictics (1992, pp. 12-18), later preferred to describe such categories as 'dimensions', acknowledging the way in which a single hand gesture may fit several categories (2005, p. 38). The same is true of gestures produced by teachers in Karnatak vocal lessons where a hand gesture may simultaneously be metaphoric (for example, indexing mapping between pitch height and hand height), and deictic (pointing to

the melody mapped onto space), while also indexing beats (significant points in the phrase). As discussed in section 1.6 of this thesis, even broad categorical distinctions such as those between sound-producing and sound-accompanying gestures are difficult to sustain. Therefore, while the functions and meanings of gestures will be examined in this thesis, including discussion of metaphoric and iconic qualities of gesture, such categories will not feature in the systematic analyses.

4.2 Research questions

Within my broad enquiry into the role played by physical gesture in Karnatak vocal lessons, two specific questions are posed:

a) What musical qualities and features are indexed by teachers' hand gestures?
b) How does such indexing contribute to the student's learning process?

In order to answer these questions I draw on theories and methods used in the fields of ethnomusicology, music cognition, gesture studies, and cognitive linguistics. Four different approaches are applied here to the study of gestures in vocal lessons, each presented in a separate chapter. The first takes an ethnographic approach, and is based on interviews with vocal teachers and their students in South India. The second employs empirical methods from the field of music cognition to ascertain the extent of correspondence between hand position and musical pitch in teachers' hand gestures. The third chapter looks at mapping between hand motion and musical motion, and considers issues of metaphor and iconicity. Finally, the fourth chapter presents an analysis of interaction between student and teacher, drawing on concepts from the wider field of gesture studies as well as from cognitive linguistics. Details of methods employed will be given in the respective chapters. However, much of the research material is common to all four chapters, and so this material and the way in which it was collected will be discussed here. In addition this introductory chapter will provide context for vocal pedagogy and co-singing gesture in Karnatak music, with consideration also given to the ethical dimension of physical gesture.

4.3 Background on the vocal teachers participating in the study

During my fieldwork in South India I conducted interviews with over thirty professional Karnatak musicians. I made video recordings of lessons given by fifteen of these musicians, nine of whom were vocalists. In this section of the thesis I have chosen to focus on three lessons given by three different vocal teachers. The choice of lessons was not made on the

basis of extent of gesturing observed; in fact, with two notable exceptions that will be discussed later in this chapter, all of the vocal teachers recorded produced co-singing gestures during almost every phrase while teaching *rāga ālāpana*. Instead, lessons were chosen based on features such as lack of interruptions, the quality of the audio and visual elements of the recordings, and the availability of the musicians for follow-up questions. While I focus on only three lessons in my systematic analyses, extracts from interviews with other teachers and their students also contribute to the chapters that follow.

The three teachers whose lessons are analysed in detail in this thesis were born and raised in South India, and all are experienced teachers as well as respected performers. Suguna Varadachari is perhaps the most widely known. Born in 1945 in Coimbatore, Tamil Nadu, she studied under the renowned vocalist Musiri Subramania Iyer in Chennai, and went on to teach vocal performance at the University of Madras for over twenty years. In 2010 she was awarded the title of Sangita Kala Acharya by the Madras Music Academy: an award specifically recognising her skill and influence in pedagogy ("And the Awards Go To…" 2010). She is known for her adherence to tradition in her vocal style and for her skill in the performance of *niraval*, one of the improvisatory forms in Karnatak music, regularly giving lecture-demonstrations on the subject. In addition, she teaches a large number of advanced vocal students from her home in Chennai.

The second teacher whose lessons are analysed here is Dr T.S. Sathyavathi, a senior performer and teacher based in Bangalore, Karnataka. In addition to her knowledge of Karnatak music she is a Sanskrit scholar, holding the position of Professor in Sanskrit at Vidya Vardhaka College for Women in Bangalore until her retirement in 2013. Amongst her numerous awards are two for lecture-demonstrations given at the Madras Music Academy (Krishnamachari 2013). She teaches a select group of advanced vocal students from her home in Bangalore.

The third teacher whose lessons are discussed is the violinist and vocalist T.V. Ramanujacharlu, a top graded staff artist at All India Radio Tiruchirappalli, Tamil Nadu. Although primarily a violinist, he also sought out as a vocal teacher due to his profound knowledge of *rāga*, subtlety of style, and extensive repertoire of compositions, learnt from his guru Nallan Chakravartula Krishnamacharyulu. T.V. Ramanujacharlu was taught through the traditional *gurukula* system, living at his teacher's house between the ages of 10 and 17. He regularly performs as a violinist with renowned vocalists, including T.M. Krishna and T.V. Shankaranarayanan.

These three teachers were chosen for their dual expertise as performers and teachers. They can also be viewed as representing different areas of South India;[21] Suguna Varadachari studied, taught, and still lives in Chennai, and her *guru-shishya* (teacher-student) lineage is also firmly rooted in Tamil Nadu; T.S. Sathyavathi is based in Bangalore, Karnataka, and was taught by R.K. Srikantan, whose lineage descends from musicians of the Mysore court;[22] T.V. Ramanujacharlu originates from and studied under his guru in the South Indian state of Andhra Pradesh, before moving to Tiruchirappalli in Tamil Nadu to take up a position as a staff artist at All India Radio. These three teachers, therefore, together represent three of the four states of South India. While there is now no clearly defined stylistic difference in Karnatak music based on state or region, the style does vary to some extent between lineages, and so in order to take a broad view of practices in the style, it is desirable that the three teachers whose lessons are analysed here should originate from different *guru-shishya* lineages.[23]

Having introduced the teachers whose lessons are analysed in this thesis, in the next section I will provide context for the lessons by describing the pedagogic formats commonly employed for teaching Karnatak music in contemporary South India.

4.4 Pedagogic formats in South India

Vocal teaching in South India occurs in two broadly defined contexts: institutional settings such as music colleges, and private tuition in teachers' homes. Institutional music training is a fairly recent phenomenon in South India. Two music schools were established in Triplicane (an area of what is now called Chennai) towards the end of the 19th century, with larger music colleges and university music departments opening from around 1919 onwards (Unnikrishnan 2006, pp. 54-55; Subramanian, L. 2008a). Before the advent of institutional teaching, musicians were trained through the *gurukula* system where the student became part of the *guru's* household, living in their home and helping with chores (Unnikrishnan 2006;

[21] The four states of South India are Tamil Nadu, Karnataka, Andhra Pradesh, and Kerala. Chennai, formerly Madras, is the capital of Tamil Nadu, and Bangalore is the capital of Karnataka.

[22] Mysore, a city in what is now the state of Karnataka, was the seat of a royal court whose maharajas gave patronage to many performers and composers, particularly from the 18th to early 20th centuries. R. K. Srikantan's *guru-shishya* lineage descends from Mysore Sadashiva Rao, and Veena Sheshanna who were prominent musicians at the Mysore court.

[23] Schools of performance in South India largely arise from the influence of individual teachers on their students and other young performers, rather than being regional variants. In *vīṇā* performance there were schools that extended to regions, including the Mysore, Trivandrum, Andhra and Tanjore styles. However, the borders between these styles have become blurred since the advent of radio broadcasts and the easy availability of audio recordings (Subramanian, K. S. 1986, p. 13).

Pesch 2009 pp. 149-150).[24] While students now rarely live in the home of their teacher for many years (unless they are a member of the teacher's immediate family), tuition in the teacher's home has survived the establishment of music colleges, with many students choosing to learn privately with a performer rather than attend an institution. Furthermore, I have observed that the practice of assisting with the teacher's chores is still in place to some extent, and students may even live at the teacher's home for short or extended periods if circumstances both require and allow it.[25]

In this study, I have chosen to focus on lessons that take place in teachers' homes rather than in institutional contexts for a number of reasons. Although institutional tuition can be a good way of obtaining initial and intermediate level training, most advanced music teaching still occurs in the homes of professional performers who are often not teachers in music colleges but rather touring musicians, All India Radio (AIR) staff artists, or, increasingly, members of another profession entirely.[26] My research focuses on musical forms and skills that are imparted during more advanced training, for which home tuition is a more typical context. Another reason for focusing on tuition in home contexts is that the institutional teaching I have observed is often, although not always, conducted in large group settings with limited one-to-one interaction. One-to-one or small group teaching provides clearer interactions between teacher and student, and is thus a more suitable context for my analysis of gesture. I use the term small group teaching for lessons given to between two and five students, during which the teacher may typically impart a composition to the group as a whole but at certain moments will ask students to sing alone while the others look on. It is in one-to-one teaching scenarios that the interaction, both musical and gestural, between teacher and student is richest, as only when the student is singing alone can the teacher properly hear what is being sung and respond accordingly.

In the course of my research I observed and videoed lessons in a large range of contexts, including large group teaching at the University College of Fine Arts in Mysore University and lessons in the homes of over fifteen performers located across South India. The lessons chosen for analysis in this thesis all took place in teachers' homes. Two are one-to-one lessons, and one, the lesson given by Suguna Varadachari, is a period of one-to-one tuition that occurred within the context of a small group lesson. Such alternating between one-to-one and small group teaching within a lesson is common, as teachers recognise that

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[24] As musicians often preferred to pass on their knowledge to members of their own extended families, staying in the house of the *guru* often meant staying in the house of a family relation.

[25] Caste restrictions regarding food preparation can make it difficult for those from a 'lower' caste to live in the home of a teacher from a caste that is considered to be higher.

[26] It is not uncommon to find excellent musicians who have full time jobs in other professions, while also pursuing a career as a performer and teaching a few students when time allows.

their students can learn much from observing the tuition of others. In the Karnatak tradition, great significance is given to listening to and being in the presence of music performance, either in the form of concerts, informal music making, or the lessons of other students (Grimmer 2012). Lessons can be prolonged affairs for the students, involving hours of waiting and listening while others play. Meanwhile, the student's own lesson may be relatively brief, perhaps as short as 15 minutes if the teacher's schedule is full. However, the teacher may devote hours to a single student if he or she is preparing for an immanent concert, competition, or grading.[27] The lessons analysed in this thesis were between 30 and 72 minutes in length.

4.5 *Rāga ālāpana* as it is taught in vocal lessons

Karnatak music consists of many musical forms, including various types of compositional and improvisational formats as described in section 2.3 of this thesis. In my experience of observing lessons and learning the style, teachers tend to focus on imparting large numbers of compositions in different *rāgas* to their students, as it is through learning and memorising compositions that the ability to improvise is believed to arise. In traditional Karnatak pedagogy, there is no rote learning of individual phrases for use in improvised formats such as *rāga ālāpana*, *niraval*, and *kalpana svara*, so it is through the learning of compositions that students become familiar with the melodic motifs that are characteristic of each *rāga*.[28] These may then be used and developed within the various improvisational formats. Although Viswanathan (1977) noted that systematic training in *rāga ālāpana* is 'traditionally inconceivable' (p. 15), this appears to have altered since his time, as most of the teachers I encountered sometimes included a period in the lesson devoted to imparting *rāga ālāpana*, *niraval*, or *kalpana svara* to their students, typically requiring imitation of phrases spontaneously produced by the teacher. However, it is still the case that such training is only offered in addition to the long process of learning large numbers of compositions and listening to the performances of professional musicians in order to implicitly learn the melodic motifs characteristic to each *rāga*.

In the analyses presented in the following chapters of this thesis I will focus solely on sections of lessons where the teacher gives tuition in *rāga ālāpana*. My reasons for this are twofold. Firstly, *ālāpana* is commonly considered the most aesthetically significant

[27] All India Radio (AIR) runs grading sessions, establishing the performance level of both junior and senior artists, grading them as B, B-high, A or A top level.

[28] As explained in section 2.3 of this thesis, *rāga ālāpana* is a form of improvisation without metre sung to meaningless syllables and performed before the composition, *niraval* is improvisation on a line of the composition, and *kalpana svara* is improvisation with rhythmic metre, sung to *sargam* syllables and performed after the composition.

'improvisational' form in the style. For example, Deva (1973) proposes that 'the *alapa* [*ālāpana*] is the most sensitive and fundamental part of *raga* enunciation' (p. 34). Such opinions perhaps arise from awareness that it is only in *ālāpana* that the *rāga* can be elaborated on at length without any adjustments made to suit metre or *sāhitya*, thus allowing the fullest expression of the *rāga's bhāva*. My second reason for focussing on tuition in *rāga ālāpana*, is that the co-singing gestures arising during this form tend to be primarily connected to the musical content, while the gestures that co-occur with the singing of compositions are often more linked to the expression of *sāhitya* (lyrics) and the passing of the *tāla* (metrical structure). When performing any of the musical forms that have a metrical structure, tradition dictates that the vocalist should indicate the passing of the *tāla* with his or her right hand. The term *tāla* is used to refer both to the metrical structure itself and also to the codified system of hand and finger movements used to indicate the progression of the metrical structure through time. Vocalists must perform these hand beats while singing any musical form that has a metre, including compositions, *niraval*, and *kalpana svara*. *Rāga ālāpana* is not sung to a metre, and is, therefore, the most commonly performed musical form during which both of the vocalist's hands are available for spontaneous gesture. The singing of *rāga ālāpana*, with its freedom from putting *tāla* and conveying *sāhitya*, appears to afford gestures that are linked primarily to melodic motion, and so the teaching of this musical form will be the focus of the chapters that follow.

In the course of my fieldwork I have observed two pedagogic techniques used to teach *rāga ālāpana*. In the first, which I will refer to as the 'teacher demonstration model', the teacher presents spontaneous phrases of *ālāpana* with an overall form that might be used in concert performance, but leaving a pause after each phrase and waiting for the student to imitate it before continuing on to the next. The second pedagogic technique, used more frequently when teaching advanced students, requires that the student sing *rāga ālāpana* without demonstration by the teacher, as though they were giving a performance. The teacher then interrupts to correct errors or suggest more appropriate phrases. I will refer to this second type as the 'student presentation model'. Sessions often consist of a mixture of the two types, sometimes beginning with the student presentation model and shifting gradually towards teacher demonstration if the student fails to show sufficient fluency in the *rāga*.

It should be noted that neither of these models are forms of rote learning. The student is not expected to deliberately memorise the phrases, and unless the student makes an error, the phrases will not be repeated unless they reoccur in the natural flow of the *ālāpana*. The process of learning to perform *rāga ālāpana* occurs through the gradual assimilation of

characteristic phrases (*sañcāras*), rather than through deliberate memorisation.[29] The teaching session acts as a model for not only individual phrases but also the progression of the *rāga ālāpana* as a whole. For the teacher's *ālāpana* to progress in a satisfying manner it is important that flow is achieved, and so verbal interaction is kept to a minimum. Therefore, it seems possible that the prevalence of gesture during *rāga ālāpana* teaching is due, in part, to the need to convey musical information without breaking the flow of the *ālāpana* by resorting to verbal correction.

In the next section, I will expand the purview of my contextualisation of gesture and pedagogy, by presenting a discussion of Indian cultural and social attitudes towards gesture in musical contexts.

4.6 Ethical constraints on gesturing in vocal lessons and performance

Although the majority of teachers observed during my research gestured while singing, there were notable exceptions; two musicians who were blind since birth or early childhood produced virtually no co-singing gestures while performing and teaching. The musicians in question were Hamsini Nagendra, a Bangalore based vocalist, and Uday Kiran, a Mysore based violinist and vocalist. Furthermore, these two vocalists were unusual in that they held broadly negative attitudes towards gesturing, whereas the sighted vocalists interviewed held generally positive attitudes towards co-singing gestures. I would suggest that the negative attitudes held by the two blind vocalists can be traced back to censorious attitudes towards 'excessive' gesturing, expressed in particular by music critics. Such attitudes can, in turn, be viewed as emerging from notions of purity and spirituality that were emphasised during the reform of Karnatak music in the first part of the 20th century (see section 2.2). Rahaim (2008) notes that Indian music critics have tended to censure vocalists for gesturing deemed to be excessive; for example, admonishing singers for making 'violent and spasmodic physical movements' or 'futile gestures of the hand' (Rahaim 2008, p. 327). Such attitudes can also be found in popular culture. Rahaim observes that in Indian cinema, flamboyant physical gesture is often portrayed as opposed to true spirituality. He provides an example of a song sequence from the film Saint Tukaram (1936), in which a vain, hypocritical priest gestures wildly as he sings florid melodic runs, at one point nearly hitting someone in the face, while the truly spiritual protagonist, Tukaram, hardly moves at all as he sings simple, unadorned songs

[29] Compositions are, however, deliberately memorised during practice. Teachers typically provide basic *sargam* notation for compositions, often written out by hand during the class; printed books of compositions are rarely used as the aim is to impart the version of the composition preferred by that teacher, usually based on the version taught to them by their own guru. Students may make audio recordings of their lessons in order to assist memorisation of the particular *gamakas* and *sañcāras* performed by the teacher, while in the past students relied solely on their memory of the lesson.

(Rahaim 2008, p. 328). As Rahaim notes, the comparison in this song sequence points to the notion that the spiritual lies beyond the body, while the body and its movement is morally suspect. With purity signposted by lack of gesture, it is no wonder that female Karnatak vocalists in particular have, during the 20th century at least, felt the need to keep gesture to a minimum (Weidman 2006, pp. 129-135). However, practices may be shifting somewhat, as in present-day India, although female vocalists still present a restrained physical presence on stage, the majority of female singers do gesture while performing *rāga ālāpana*.

Additional censure against physical gesture can be found in Indian music colleges and university music departments, many of which include a section in their syllabi listing *gāyaka dosha* (the faults of singers) (see for example, University of Calicut, 2012) in which excessive gesturing is sometimes included. One of Hamsini Nagendra's students stated that during her university studies she had been taught that gesture was a *gāyaka dosha*, and that such *doshas* (faults) were listed in musical treatises (Ranjani Badrinath, personal interview, Bangalore, January 4, 2014). The 13th century *Saṅgīta-ratnākara* includes such a list of *doshas*, and although gesture is not explicitly mentioned, the list does include faults such as 'shaking of limbs and voice' and 'one who twists his neck while singing' in amongst the many possible vocal imperfections (Shringy and Sharma 2007b, pp. 156-157). Interestingly, while Ranjani Badrinath (the student of Hamsini Nagendra) expressed relatively negative opinions regarding gesture, she still gestured while singing. In this case, the proscription derived from theory remained theoretical.

Surprisingly, considering the censure against vocalists' gestures found in journalism, popular culture, and institutional music education, all of the teachers I interviewed in South India (with the exception of the two blind vocalists), believed that gestures had a positive impact on both the learning process and concert performance. In fact most found the idea of sitting entirely still while singing laughable; upon being asked whether gestures were helpful in the learning process or in performance, several teachers demonstrated singing without gesture to the amusement of themselves and their students (for example, interview with Koviladi Kala, Mysore, August 12, 2013). My conjecture regarding the converse opinion held by the two blind vocalists interviewed during my research is that in the absence of any first-hand experience of observing co-singing gestures, they had been unable to feel the beneficial impact of gesturing, either as a teacher or student. Instead their main sources of information regarding gesture in musical contexts were the negative opinions of music critics and theoreticians. The absence of gesturing seen in lessons and performances given by Hamsini Nagendra, Uday Kiran, and also the very well known blind Karnatak vocalist, Dr Gayatri Sankaran, indicates that although co-singing gestures are not explicitly taught, they must be learned implicitly through observation of teachers and other performers. Indeed, it takes young vocalists many years to develop gesturing habits in which the hand motions are clearly

and gracefully linked to melodic motion, as seen in more experienced performers. For students there is an additional concern with regard to their own gestures, which is that they should not be more flamboyant than those of their teacher. This is because, as in everyday life, the extent of a person's gestures tends to convey information regarding that person's assessment of his or her status in relation to others present; large and flamboyant gestures are typically only performed by people who feel they are of equal of higher status compared to others present. Therefore, most students, due to restrictions based on status as well as inexperience with gesturing, tend to produce small and unobtrusive gestures. However, students' gestures still convey information and play a role in the pedagogic process, as we shall see in chapter 8 of this thesis.

In addition to presenting the research questions to be addressed in this section of the thesis, this chapter has provided context required to understand the analyses that follow. The next chapter will consider the questions posed here regarding the role of gesture in vocal lessons, through a thematic analysis of interviews conducted with Karnatak vocal teachers and their students in South India.

5 Karnatak Musicians' Opinions on Gesture in Pedagogy

5.1 Introduction and methods

In this chapter the role played by gesture in Karnatak music pedagogy will be explored through a discussion of views expressed by teachers and students when interviewed on the topic. The chapter will focus in particular on answers from participants relating to the two main questions posed in this part of the thesis: what musical qualities and features are indexed by teachers' hand gestures, and how does such indexing contribute to the student's learning process?

In the course of my fieldwork in South India, I conducted semi-structured interviews with over thirty Karnatak musicians and made video recordings of vocal lessons given by nine different vocal teachers. In cases where lessons were videoed, I conducted the interview with teacher and student after the teaching session in order to prevent the participants from becoming self-conscious about their gestures before the lesson itself. This precaution was taken due to my concern that such self-consciousness regarding gesture might lead to changes in the participants' normal gesturing habits. Further to the same end, I initially explained my research as being concerned with the learning process in Karnatak music. My interest in physical gestures became apparent during the interviews after the lessons, and I clarified that this was a major focus of my enquiry at the end of the session when formal permission was sought to use the interviews and video recordings for research purposes. For logistical reasons, the majority of interviews were conducted with teacher and student together. This arrangement was largely positive, as the discussions between teachers and students were often illuminating. Follow-up interviews were conducted several months later with all three teachers individually, in which I showed them the video of the lesson and asked them to comment on various interactions.

Interviews were conducted in English, as participants' mother tongues spanned three languages: Tamil, Kannada, and Telugu, the official languages of Tamil Nadu, Karnataka and Andhra Pradesh respectively. All participants had a good grasp of the English language. The majority of the students interviewed had attended English medium schools, and all of the vocal teachers used English to varying degrees in their professional lives. English is an official language in India, and in the southern states of India it is used in preference to Hindi, which is largely shunned due to the populaces' desire to retain their local languages. When answering my questions, participants tended to use the original Sanskrit for musical and

religious terms, as they were aware that I would understand due to my background studying music in South India. Occasionally participants used non-Indian musical terms in place of the Sanskrit; for example, one or two vocalists made reference to musical 'notes'. I have observed that the word 'note' is often employed by Indian musicians and musicologists who are in the habit of frequently conversing in English. This might simply result from an urge to translate the Sanskrit term *svara* into English, notwithstanding the fact that the two terms have quite different meanings (see section 2.4). However, it could also be due to the absence of a single term in Karnatak music for all of the individual pitches touched during the performance of a *svara-gamaka* unit, which might include the primary *svarasthāna* plus various *anusvaras*.[30]

During the interviews, my main questions directed to teachers were as follows:

- Do your hand gestures indicate or show anything about the music? If so, what?
- Do your gestures help your students during the lessons? If so, how?

Students were asked the same questions, but referring to 'your teacher's gestures' rather than 'your gestures'. Follow-up questions varied depending on the answers to these initial questions.

The audio recordings of interviews were transcribed and subjected to qualitative analysis for themes relating to the two research questions posed here. The analytical approach used is akin to the 'thematic analysis' methods outlined by Braun and Clarke (2006). Following transcription and familiarisation with the interviews, I noted all instances in which an interviewee suggested that gestures indicated or were connected to a particular musical quality or feature. This initial thematic analysis was semantic, noting the words used by interviewees to describe such musical qualities and features. I then placed these semantically derived themes into groups of terms I identified as being closely related, and created a thematic map (see Figure 5.6), which will be considered at the end of this chapter. The discussion that forms the main part of this chapter aims to highlight the principal themes identified, and also to clarify the connections that exist between them, but first it is worth considering in more detail participants' attitudes towards gesture in musical contexts.

5.2 Attitudes towards the topic of gesture

Although I had spent several years learning to play Karnatak music in South India before starting my research, I was unsure of how teachers and students would react when asked

[30] The structure of *svara-gamaka* units is explained in sections 2.4 to 2.8 of this thesis.

about the topic. In the course of my training and also during observation of other students' lessons, I cannot remember any instances of hand gestures being discussed, although I have seen teachers correct students' physical posture, head movements, and facial disposition. Outside of lessons, vocalists' gestures tend to be discussed rarely, and only in the context of criticism of a performer whose gestures are deemed unnecessarily flamboyant, unattractive, or derivative (see section 4.6). As a result, any positive qualities of gesture are virtually absent from musical discourse in South India. Considering that the subject of gesture arises so rarely in the natural course of their musical practice, I wondered whether musicians might struggle to discuss the topic when interviewed. However, I found quite the opposite; most teachers and students were able to give immediate and full responses that included many interesting insights into the role played by gestures in lessons.

The majority of teachers and students responded in the affirmative when asked whether gestures produced by teachers during lessons helped students learn, providing different ideas on what the gestures could convey to the student.[31] Only one student interviewed showed initial uncertainty when asked whether the gestures were helpful. This was T.S. Sathyavthi's student, Ashwini Satish, whose lesson I recorded in Bangalore in January 2014. However, her initial uncertainty was quelled when her teacher demonstrated a phrase both with and without gesture. After this, Ashwini became enthusiastic, and seemed amazed that she had not thought about the gestures before. In the following exchange and hereafter, the initials TS refer to T.S. Sathyavathi (the teacher), AS to Ashwini Satish (the student), and LP to me (the interviewer).

> AS – Today I am thinking about this [for the first time].
> TS – It is just ingrained you know. They [the students] take it like this.
> AS – We are used to that [gesturing], but [only] today we are thinking about this, whether it helps us.
> TS – See, if you ask a child whether he's enjoying some food, 'mmm it's very nice' he says. When you ask which particular ingredient [he] likes more in that, he can't say. But if you don't put that particular ingredient, he will not like it. But he will not know which particular one.
> LP – But you understand.
> TS – Yes, mother knows.
> (TS and AS, personal interview, Bangalore, January 4, 2014)

[31] Amongst teachers, the only exceptions to this positive attitude towards gesturing were the two blind vocalists, whose perspectives were discussed in section 4.6.

The response of the student here suggests that teachers' gestures are so ubiquitous that some students barely notice their presence. It is rather the absence of gesture that would be remarkable. Indeed, a common response from teachers when asked about gesture was to sing a phrase both with and then without hand movements, at which point students and teachers alike would typically smile at the ridiculousness of singing without gesture.

In the exchange above, the teacher's comments suggest she is aware that her gestures help her student. However, teachers also tend to emphasise that their gestures are spontaneous: occurring without deliberate effort. A typical comment along these lines was made by T.S. Sathyavathi (hereafter TS) who described her indication of *svara* movement through gesture as occurring 'without my own knowledge' (TS, personal interview, Bangalore, August 11, 2014). Similarly, when describing the relationship between gesture and melodic movement on another occasion, TS used the phrase 'automatically my hand also does that' (TS, personal interview, Bangalore, January 4, 2014). Other teachers also described their gestures as occurring 'automatically' (Koviladi Kala, personal interview, Mysore, December 19, 2013). It seems therefore, that while teachers believe their gestures play a role in the learning process, the gestures appear to them as arising without either their awareness or deliberate control.

One particular exchange that took place between TS and her student demonstrates this combination of the teacher's awareness of the role played by her gestures along with the spontaneous and 'automatic' nature of their production. Near the beginning of the lesson TS noticed that her student's eyes were closed, and immediately said '*nodini nana*' (in the Kannada language), meaning 'look at me'. The student quickly looked up at her teacher who sang the phrase again with a gesture in which she stretched her hand out to her student with the palm open and facing upwards: an emblem gesture used in daily life to convey 'come with me', but here implying also 'give me your attention'. When, several months later, I played this video back to TS, she had no recollection of this exchange in the lesson, and was surprised to see it. She noted:

> That's really interesting. I'm trying to communicate through my gesture also. She has closed her eyes. [...] I want her to look at me when I'm teaching. Yes, they learn more by looking at the guru. (TS, personal interview, Bangalore, August 11, 2014)

Her relative surprise at this exchange implies that although TS believes that the gestures help her student, both her gestures and her maintenance of her student's observation of these gestures are spontaneous and arise in the moment without a high degree of awareness. This spontaneity notwithstanding, we shall see in the following discussions that both teachers and students provided insightful comments about the role played by gestures in lessons.

5.3 Themes observed in responses

In the remainder of this chapter, I discuss some of the main semantically derived themes found in the teachers' and students' responses. The themes identified are considered in separate sections below; however, as will be seen, the themes often overlap. Sometimes this is due to semantic ambiguity or polysemy. The term *svara* is particular complex as it can be used to refer both to a position in the theoretical *rāga* 'scale' and also to the *svara-gamaka* unit that is realised in practice (see section 2.4). As the interviews deal with the Karnatak style as it exists in practice, use of the term *svara* usually implies also the *gamaka* with which it is played. Therefore, the sections on *svara* and *gamaka* overlap to a large extent. Other connections between sections may also be seen. For example, the word 'movement' tends to be used by musicians in relation to the 'movement' of a *gamaka*, or of a *svara* performed with a *gamaka*. Nevertheless, I have maintained separation between the themes in order to adhere closely to the interview material.

5.3.1 Movement

The word 'movement' was used by several different musicians during interviews. When asked what features of the music are indicated by gesture, the Srirangam based teacher, T.V. Ramanujacharlu (hereafter TKV), replied with an unprompted reference to the kinetic quality of music, stating, 'I want to show the movement of the *saṇgati* [phrase], [the] movement of that phrase' (TKV, Srirangam, August 16, 2014). When questioned further on what he meant by movement, TKV proceeded to sing a short phrase, indicating the location of each *svara* in the space in front of his body: '*Ga ga* is here [shows position with hands] *pa* is there, *ma ga* is down.' (TKV, Srirangam, August 16, 2014). In this way, TKV demonstrated a mapping between *svara* positions and hand position in the space in front of his body, in which his co-singing gestures described the melodic movement between *svaras*. This mapping between hand position and *svara* will be discussed further in the next section; however, the point being made here is that TKV expressed the connection between gesture and music as one in which the hand shows the melodic 'movement' of the phrase.

The Bangalore based teacher, TS, made a statement, which, like that of TKV, also refers to the kinetic musical qualities communicated by hand gesture:

> According to me, it is impossible to teach Karnatak music, particularly without all those intricate things, without hand gestures. You can't sit like a rock and teach Karnatak music and make the student understand the beauty of it or the particular

> *saṅgatis* […] the gestures have to be there. They are integral. The movements are so many, and so varied. They are. The movement of the *svaras*, they are so different, so varied. To make them understand, make the student understand […], you have to use the gestures. (TS, personal interview, Bangalore, August 11, 2014)

In this explanation, TS uses the term *svara* in the sense of the *svara* together with its associated *gamaka*: the phrase 'intricate things' refers to *gamakas*, which we had previously been discussing. This section from the interview conveys a large amount of information. TS clearly feels that teachers' gestures can help their students 'understand' particular phrases and the 'movement of the *svaras*' within these phrases. The comments made by TKV and TS here demonstrate that both teachers hold a conception of melody as motion, and are aware of the connection between their hand gestures and melodic movement. These topics will be addressed further in chapters 6 and 7 of this thesis.

5.3.2 *Svara* and pitch position

The comments of several teachers included reference to the idea that gestures indicate *svaras*. This information was typically imparted through a combination of explanation and demonstration, in which the teachers gestured in a way that showed pitch position roughly mapped onto hand position in the space in front of their bodies, with high pitches placed higher in space than lower pitches. From their descriptions and demonstrations it is clear that the *svara* positions shown in space are not absolute or fixed, but, instead, are relative to the pitch and hand position of the previous *svara*. For example, in the demonstration and description given by TKV above, the *svaras ma* and *ga* are 'down' from where *pa* was placed; there is no suggestion of a fixed spatial position for *ma* and *ga* (TKV, personal interview, Srirangam, August 16, 2014).

Nevertheless, although the hand positions are relative to each other, the starting position of the phrase is not random: high initial pitches tend to be placed higher in space, and low initial pitches tend to be placed lower. This was demonstrated by one of Suguna Varadachari's (hereafter SV) students who explained, 'and in case we are singing something in the lower octave we don't usually show this way [she places her hand high up in the air]' (SV and three students, personal interview, Chennai, December 28, 2013). The student then demonstrated a phrase starting on a mid-level pitch, with a gesture that originated with her hand held just above her knee. As the phrase descended, her hand also descended and the lowest *svara* in the phrase was indexed by a distinct gesture placed at a lower position than any other hand movement accompanying the phrase.

All musicians who discussed the relationship between *svara* and hand position during interviews demonstrated the mapping in the vertical axis, with high pitched *svaras* placed high in space and low pitched placed low. This is in line with cross-domain mapping between pitch height and physical height found in many cultures, but which is, however, not universal.[32] The following explanation given by TS further illustrates both of the points discussed here regarding the indexing of *svaras* relative to each other, and their mapping in the vertical axis:

> The upward movement of the notes are indicated by the movement of my hand. *Ri ga ma pa* [she sings the phrase using *sargam* syllables]. *Ga* is higher than *ri*, *ma* is higher than *ga*. So that is also indicated by my movement, without my own knowledge. (TS, personal interview, Bangalore, August 11, 2014)

At the end of her explanation here, TS emphasises that the mapping between *svara* and hand position is made without her 'knowledge', that is to say, without prior planning or awareness as the gestures are produced.

Students interviewed who mentioned the connection between pitch height and hand position also demonstrated this mapping in the vertical axis. In the interview with TS and her student Ashwini Satish (hereafter AS), following her initial doubt about what gestures might convey, AS watched her teacher singing a phrase and considered her gestures for possibly the first time. The phrase sung by TS was a series of descending *svaras*, each ornamented with what in Western classical music would be termed an upper mordent: *pa-dha-pa-ma*, *ma-pa-ma-ga*. TS accompanied each of these descending motifs with a hand movement in which the wrist turned slightly in towards the body so that the fingers of the hand moved downwards. The student then enthusiastically noted:

> See, it is stepping down actually [she imitates the phrase and gesture previously sung by TS]. She is doing like this [gesturing with downward turns]. It helps. (TS and AS, personal interview, Bangalore, January 4, 2014)

[32] For discussions on culture dependent variance in cross-domain mapping see Zbikowski (1998), Ashley (2004), Eitan and Timmers (2010), and Dolscheid et al. (2013).

Figure 5.1: Ashwini Satish demonstrates the 'stepping down' gesture that starts high with the palm turned up, and then, with a twist of the forearm and wrist, moves lower with the palm facing down.

The stepping down gesture performed by AS can be seen in Figure 5.1. In this interaction, it is interesting to note the differences between the gestures made by teacher and student for the same phrase. The teacher's initial demonstration shows a downward hand movement to coincide with the downward pitch movement within each motif, but there is no overall downward progression in the hand position mirroring the downward pitch progression of the phrase as a whole; instead, the hand turns upwards each time to start the next motif. Conversely, when the student sings the same phrase, in addition to the downward turning hand movement on each motif, there is also a mapping between position and space over the phrase as a whole; each motif is shown at successively lower positions in front of her body. This comparison demonstrates the variety that can be seen in mappings between pitch and hand position. Sometimes only certain parts of a phrase's pitch contour may be mapped onto position in space, while at other times the mapping may be more comprehensive.

The comments by teachers and students regarding gesture and *svara* demonstrate that Karnatak musicians not only tend to map pitch onto vertical height, but also that on reflection they are aware of this mapping. However, as can be seen from one student's initial uncertainty about the role played by gestures, the topic is rarely discussed. Furthermore, musicians describe this mapping as occurring 'automatically' and without their own 'knowledge' in the moment that the gestures are produced. One example discussed shows that mapping between pitch contour and hand position may occur either in part or across the whole of a given phrase. Cross-domain mapping between pitch and hand position is explored further in chapter 6 of this thesis, where three lessons by different teachers are examined to determine the extent and characteristics of such mapping.

5.3.3 Gamakas

One of the musical features most frequently identified by both teachers and students as being shown by gesture was *gamaka*. During an interview with TS and two of her students, one student suggested that 'gestures tell us how we have to sing the *gamakas*' (TS and two students, personal interview, Bangalore, August 17, 2013). This was the student's first suggestion, made without prior mention of *gamaka* in the interview. Following this comment, TS explained that a gesture could, for example, show the extent of the 'curvature' in a *gamaka*, a statement that demonstrates a conceptual mapping between gesture and musical shape. In this case the 'curvature' mentioned might have been a reference to either pitch contour or another musical feature that could be described as having a curved quality, such as change in dynamics.

Other students also commented on the role played by gesture in communicating the proper performance of *gamakas*. Madhuri Kaushik (hereafter MK), a student of Sukanya Prabhakar, a vocal teacher based in Mysore, explained the connection between *gamaka*, *bhāva*, and gesture with particular clarity:

> So when you sing a *kriti* […] you're actually giving the *bhāva* in that through the *gamakas* [sings two phrases from a *kriti*]. So when madam [her teacher] is showing this […] [she sings a phrase with a slide up to the pitch, accompanied by a rising and arching gesture in the hand movement] she shows me this [makes the arching gesture again]. That means I have to use my voice like [she sings the phrase with the arch gesture and a vocal slide] not like [she sings it again without the arch gesture and with far less vocal slide up to the *svara*]. [This] is also possible, but [she sings the phrase with the arch gesture and a vocal slide up to *svara*] gives a better *bhāva*, a better *gamaka*. So that's how the gestures help me. (MK, personal interview, Mysore, July 25, 2013)

Here, the student makes three important points. First, *bhāva* emerges due to the correct performance of *gamakas*. Second, teachers' gestures can help students understand how to sing *gamakas*, indicating that they should sing in a way that is 'like' the gestures: effectively taking something from the shape and motion of the gestures and applying it to their vocalising. Third, when the rendition of a phrase is altered, the gesture that accompanies it is likely to do the same; the vocal slide up to the higher *svara* was accompanied by an arching gesture, but the vocal rendition with very little slide was accompanied by a different gesture in which MK's hands moved sideways, away from the centre of her body (see Figures 5.2 and 5.3 for each of these gestures).

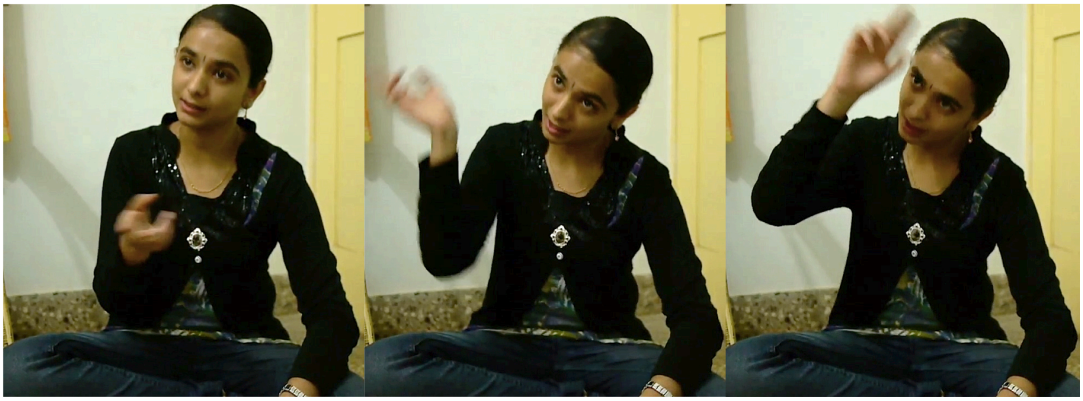

Figure 5.2: Madhuri Kaushik demonstrates a *gamaka* in which there is a slow vocal slide from a lower to a higher pitch accompanied by an arching gesture (the progress of the gesture through time is shown here, starting at the picture on the far left).

Figure 5.3: Madhuri Kaushik demonstrates a *gamaka* in which there is very little slide between the lower and higher pitch accompanied by a sideways gesture.

As well as clarifying the connection between *bhāva, gamaka,* and gesture, MK's explanation demonstrates the ease with which musicians are often able to express this connection.
The Chennai based teacher, SV, also expressed the opinion that teachers' gestures can help students understand *gamakas*. In the interview, which took place in the presence of three students to whom she had just given a lesson, she went on to provide an example, singing a motif comprised of two *svaras*, *pa-ma*, in *rāga* Mukhāri. In this context, *madhyama* is sung as an oscillation between the *svaras* above and below it: between *pañcama* and *gāndhāra*. SV first sang the two *svaras* with no gesture, and then with a gesture in which her hand was held high for *pañcama* before oscillating back and forth, mirroring the vocal oscillation for *madhyama*. She went on to explain that with the gesture 'It will be easy […] those students will understand that that *ma* comes from *pa*, [they will understand] that shake' (SV and students, personal interview, December 28, 2013). SV then sang the phrase again without gesture, and shook her head to indicate that this was not a good way to convey the 'shake'. In

this case the mapping between *svara* and hand position, mentioned by many teachers, allows the student to understand the pitches touched in the course of a *gamaka*.

As explained in chapters 2 and 3 of this thesis, *gamakas* are, in practice, not indicated in the notation provided by teachers for their students. Furthermore, the performance of each *svara* depends on its context and the *gamakas* with which *svaras* are performed, the *svara-gamaka* units, are extremely numerous, tending to defy systematic classification. Therefore, for the student of Karnatak music, understanding the pitches, rhythms, and other musical qualities required in the performance of *svara-gamaka* units is a major challenge. It is clear from the comments of teachers and students presented above, that in their opinion gestures assist in overcoming that challenge.

5.3.4 Duration and pauses

During the interviews, the terms 'duration' and 'pause' were identified as elements that could be indicated by gesture. TS's student, AS, noted that the gestures may show 'duration', explaining that in the case of the downward stepping phrase discussed above (see section 5.3.2), her teacher's hand gestures show that each motif has an 'equal duration' (TS and AS, Bangalore, personal interview, January 4, 2014). The Chennai based teacher, SV, also made a comment related to duration, using the word 'pause', in the sense of 'to linger'. After demonstrating a phrase, SV noted 'So, there is a pause'. She then demonstrated the phrase sung with no pause and no gesture, before contrasting this with a performance of the same phrase but this time with a pause accompanied by a downward pressing gesture. To clarify the meaning of the gesture, she then explained 'so you have to stay some more time there' (SV and students, personal interview, December 28, 2013).

These two comments were the only two referring to durational features, and rhythm was not mentioned at all during the interviews, although this might be explained by the lack of an equivalent technical term in Karnatak music. Another possible reason for the lack of comments on rhythm and the relatively few referring to duration is that the durations of pitches touched are implicit in knowledge of *gamakas* and characteristic phrases (*sañcāras* or *saṅgatis*). Therefore, when students and teachers note that gestures convey information regarding *gamakas* (as in section 5.3.3), they are likely to be referring not only to the musical pitches touched, but also to the relative durations of those pitches within the *gamakas*.

5.3.5 Pressure and stress

In addition to musical features that have established technical terms, such as *svara* and *gamaka*, teachers also mentioned qualities indicated by gesture that have no specialised

terminology. Following the comments made by AS on the 'stepping down' motif (see section 5.3.2), her teacher, TS, added that 'pressure' could also be indicated by gesture. She then used the same musical phrase to demonstrate her point, but accompanied by slightly different hand gestures (see Figure 5.4):

> TS - Or I put a pressure, like [makes a gesture in which her hand presses down with the fingers pinched together], put the pressure [sings the phrase together with the pressing hand gestures].
> AS - Yes, yes, put the pressure [makes the same pressing gesture as her teacher].
> TS - Stress [spoken together with a pressing hand gesture]
> AS - Stress on every first note of the…
> TS - The sequence
> (TS and AS, personal interview, Bangalore, January 4, 2014)

Figure 5.4: TS demonstrates the pressure gesture: a small but precise movement that presses forward and down (the gesture starts in the left picture and ends in the right).

During the same interview TS subsequently made a connection between the stress indicated by the gesture and vocal effort. She remarked, 'There's more breath on that note', making the pressing gesture on the word 'breath'. TS then demonstrated how gesture and pressure/stress are linked by singing a phrase without any vocal emphasis accompanied by a vague waving gesture, and then contrasted this with a demonstration of the same phrase sung with an emphasis at the start of each motif accompanied by a variation of the pressing hand gesture. To further clarify the point, TS repeated the word 'stress' accompanied by the pressing gesture at the end of the demonstration. Through this demonstration, TS shows that there is a connection between qualities of gestural motion, vocal effort, and musical emphasis; a pressing gesture is linked to muscular pressure (to create 'more breath') and resulting musical

'stress', while vague waving hand motions are associated with a smooth even vocal performance.

The fluency of the comments made by teacher and student on the relationship between gesture and musical 'stress' shows that they have a clear understanding of the connection. The use of pressing gestures to indicate musical emphasis will be discussed further in chapter 7 of this thesis.

5.3.6 *Bhāva* and the teacher's interpretation

In addition to some of the lower-level musical elements already discussed, such as *svara*, *gamaka*, duration, and stress, teachers and students also noted ways in which gesture can convey more complex and abstract qualities, such as *bhāva* (the mood expressed by a *rāga*) and the teacher's interpretation of the music.

While discussing gestures, SV brought up the subject of her *guru* Musiri Subramania Iyer, and noted, 'I can visualise [him], and the *bhāvam* automatically it will come out', thus suggesting a connection between the memory of her teacher's physical presence and her ability to connect with a *rāga's bhāva* (SV, personal interview, Chennai, December 2013). During a follow-up interview six months later, SV made a similar comment, on this occasion clarifying that the *guru's* gestures were an integral part of this access to *bhāva* gained through the imagined presence of her teacher. Furthermore, she explained that the effect would be the same for her own students after her death:

> SV - After many more years, after my death also […] if they [SV's students] sing, they know in this place the teacher will do like this [SV gestures]. That is of great benefit for the students. My personal experience, if I sing […] any of what I learnt from Musiri Subramania Iyer, today, also if I sing that song, I remember his physical structure in front of me […] the movement of the hands…
> LP – You remember that?
> SV – *Āma* [yes] I remember. [Then] automatically the *bhāvam*, like him I can touch. (SV, personal interview, Chennai, August 18, 2014)

This touching description of the way in which the remembered gestures and physicality of the teacher can help students gain direct access to *bhāva* is a testimony to their importance for some students, although in this case it is unclear whether SV is using the term *bhāva* in its technical musical sense to refer to the mood particular to a *rāga*, or in its more general sense, referring to emotion.

During the same interview, SV made comments that suggest an additional indirect link between gestures and *rāga bhāva*. She noted that by observing her gestures, her students 'can easily understand the *gamakas*, the *anusvaras*, the nuances' (SV, personal interview, Chennai, 18 August 2014), features that are commonly considered to play a significant role in conveying *bhāva* (see section 2.8). Interviews previously discussed in this chapter (for example, the interview with MK in section 5.3.3) also elucidate this indirect connection between gesture and *bhāva*, wherein gestures convey the details of *gamakas*, the correct performance of which communicates *rāga bhāva*.

A few interviewees also mentioned the ability of gesture to convey another complex musical quality, namely the teacher's distinctive interpretation or style. For example, TS emphasised the role of gesture in conveying the teacher's unique vision of a *rāga*. In her opinion the teacher's goal should be to communicate his or her individual interpretation to the student, and she views gesture as assisting in this communication:

> That individual contribution has to be there. That means you are interpreting that *rāga* in a particular way. If you want your student to realise, or, I mean sing just the way you are interpreting it, you have to make her understand by these gestures also. They help in making her understand. (TS, personal interview, Bangalore, August 11, 2014)

One of SV's students made a related comment, in which she suggested that the gestures provide insight into her teacher's approach viewed holistically:

> If I want to sing the way she is singing, if I need to do a replica of that, the hand gestures will help me to think the way she is thinking. (SV and students, personal interview, Chennai, December 2013)

Here, the gestures are characterised as providing insight into the entirety of the teacher's way of thinking and performing, thus allowing a 'replica' to be made by the student. Such comments demonstrate that gesture is viewed by some musicians as conveying holistic and higher-level aspects of music performance, in addition to the lower-level elements such as *svara* and duration.

5.3.7 Repairing student error and emphasising change

The interview with SV and her students in Chennai included some interesting comments on the role played by teachers' gestures in emphasising change within a phrase and also in repairing student error. SV demonstrated the former by singing a phrase using the syllable

'na' throughout, and then repeating the same phrase but with the syllable 'no' used on one of the *svara-gamaka* units. At the point at which the 'no' syllable was used, SV gestured more emphatically than elsewhere in the phrase, with a downward swooping motion of her right hand. Her students immediately understood the point she was making and interjected:

> S2 – Now this we only understand when she sings with [she moves her hands to indicate 'gestures']. If she sings normally [demonstrates the phrase without gesture], we do not get what she's saying in our mind, [but] when she sings [demonstrates the phrase with similar gestures to those used by SV, emphasising the syllable change] she's indicating the difference there.
> SV – Ah, difference [nodding in agreement and then repeating the phrase with the gesture indicating the different vowel sound]. […]
> S2 – She is emphasising the change.
> SV – And in which place.
> (SV and students, personal interview, Chennai, December 28, 2013)

Thus, both students and teacher show themselves to be aware that gestures can be used to highlight performance features that the teacher wishes the student to take note of.

Earlier in the same interview, the students suggested that their teacher's gestures can play a role in repairing students' errors, even if the gestures are performed alone:

> S3 – Sometimes *Māmi* doesn't even need to open her mouth.[33] If I sing something wrong, she says this [she gestures in imitation of her teacher], [so] I change the *gamaka*, the way that I sing it, then I understand what she sings.
> S2 –Through the years we have come to understand her hand gestures. It may be different with a different teacher, but with her since we have associated with her for so many years we come to know just by her action [she gestures in imitation of her teacher] what she wants.
> (SV and students, personal interview, Chennai, December 28, 2013)

Here, the comments made by the second student suggest that some of the teacher's gestures may become codified over the years through repeated use, and are used to refer to stable referents that her students will instantly understand. In the analyses presented in the following three chapters, I will explore many of the points raised by teachers and students in these interview segments, including the suggestion that gestures are used to highlight noteworthy

[33] In South India, *Māmi* is used as an affectionate, yet respectful term for an older woman.

musical features and repair student error. In addition, the tendency for teachers to develop gestures over the years that have stable referents will be discussed in chapter 8.

5.3.8 Effort: the physical movements required to sing

While most interviewees connected gestures to musical qualities, a few linked gestures to the physical effort required to sing: the motion of the entire breathing and vocal apparatus involved in performance. Sukanya Prabhakar's student, MK, made several comments in which the connection between hand gestures and vocal effort was either implicit or explicit. When I initially asked whether her teacher's gestures helped her learn, MK responded:

> Yes, definitely they do. […] When she shows this [MK moves her hands to provide an example of gesturing] I can understand that I have to give some force to that place […], to give some force to that *svara*. So in that way, the gestures do help a lot. (MK, personal interview, Mysore, July 25, 2013)

In this statement, rather than saying that the gesture indicates musical force or emphasis, MK states that the gesture shows where she has to 'give' force; in this way she focuses on the link between gesture and physical action rather than the musical result. Following directly from this comment MK went on to demonstrate a phrase with an oscillating *gamaka*. Referring to the co-singing hand gesture used in this phrase, she explained 'basically you tend to make your voice adjust to that part' (MK, personal interview, Mysore, July 25, 2013). Here, once again, she makes a connection between her voice and the hand gesture, rather than that between the music and the gesture.

Interested in her interpretation of the relationship between gesture and vocal effort, I asked MK whether she felt that her teacher's hand gestures were more connected to pitch movement or to the physical movements required to sing. She replied as follows:

> It [gesture] is mostly related to the vocal cord. The vibrations you need to give, the force you need to give in the vocal cord, that strength [she makes a punching motion with her hand on the word strength] comes throughout your body, you see. So when it comes throughout your body, you have to understand that and then sing it. (MK, personal interview, Mysore, July 25, 2013)

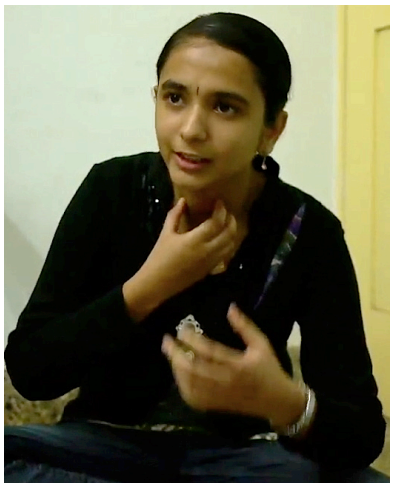

Figure 5.5: Madhuri Kaushik gestures towards her larynx while mentioning 'vocal cords', the movements of which she feels are linked to the hand gestures.

When referring to 'the vocal cord', MK used a gesture that pointed to the entire area of the larynx and upper trachea (Figure 5.5), rather than to only her vocal cords. Furthermore, her explanation quoted above seems to refer to the movement of the entire vocal apparatus. Therefore, it may be that she used the word 'vocal cord' to refer to the physical effort of singing in general, rather than the movement of that area in particular. Either way, it is clear that MK views hand gestures as linked to the physicality of sound-production, due to the connection of the two through the body.

The comments by MK differed in their emphasis compared to other students and teachers who tended to discuss musical features rather than physical effort when asked about gesture. However, she was not alone in her approach. TS also made a connection between gesture and vocal effort (see section 5.3.5 above), noting that a pressing gesture showed that 'There's more breath on that note'; at which point she made the pressing gesture to coincide with the word 'breath'. The relationship between gesture and vocal effort suggested by such comments will be discussed further in chapter 7 of this thesis.

5.4 Conclusions

The analysis in this chapter has shown that the majority of teachers and students who were interviewed believe gestures play a role in the pedagogic process. In addition, most students and teachers were able to provide details on the musical qualities indicated by such gestures. Amongst the comments identifying teachers' gestures as helpful for the student was one made by TS who noted, 'To make them understand, make the student understand […], you have to use the gestures' (TS, personal interview, Bangalore, August 2014). The word 'understand' appeared in the comments made by several teachers and students; for example, SV noted that gestures helped students 'understand the *gamakas*, the *anusvaras*, the nuances' (SV, personal

interview, Chennai, August 18, 2014); TS suggested 'They [the gestures] help in making her [the student] understand (TS, personal interview, Bangalore, August 11, 2014)'; and a student of SV commented, 'Now this we only understand when she sings with [she moves her hands to indicate 'gestures']' (SV and students, personal interview, Chennai, December 28, 2013). Therefore, the dominant view appears to be that gesture plays a role in the pedagogic process by helping students 'understand' various musical features and qualities.

The musical qualities explicitly mentioned by interviewees as being indicated by gestures included *svara*, *gamaka*, movement, duration, pressure/stress, vocal effort, *bhāva*, and the teacher's distinctive interpretation. Figure 5.6 presents a map of the themes derived from the analysis that forms the basis of this chapter. At the top of the figure I have placed the qualities mentioned that relate to the pedagogic process, including the tendency for gestures to contribute to student 'understanding' and 'error repair'. Below this I have placed the higher-level musical qualities that interviewees mentioned as being indicated by gestures, namely '*bhāva*' and 'the teacher's interpretation'. Finally, at the base of the figure I have placed the lower-level musical features mentioned by interviewees, including 'movement', '*svaras*', '*gamakas*', 'duration and pauses', 'pressure and stress', and 'vocal effort'.

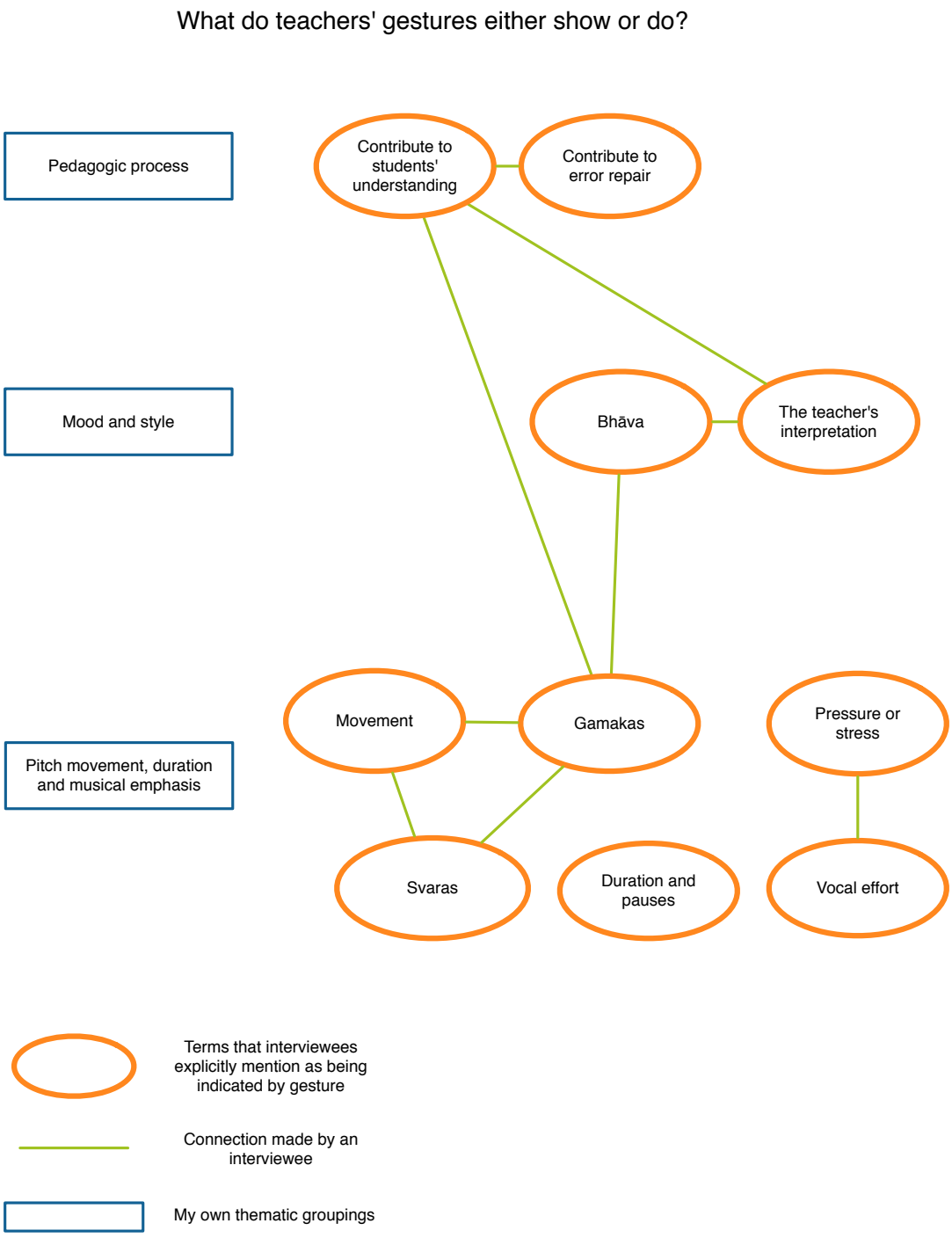

Figure 5.6: This figure presents a thematic map of teacher and student responses to my questions on gesture and the pedagogic process. The terms here arose in response to my questions asking what do gestures show, and what role do gestures play in the learning process.

The thematic map also displays the connections made by interviewees between the themes, visualised here as green lines. In this figure I have shown only those connections explicitly made by teachers and students within the same answer. However, other connections also exist; for example, all of the themes at the lowest level in the figure are implicated in *bhāva*

(see sections 2.5 to 2.8), and patterns of musical emphasis are integral to the correct performance of many *svara-gamaka* units (see section 2.8). The thematic map (Figure 5.6) highlights the pivotal nature of '*gamakas'* with numerous interviewees making explicit connections between this and other features indicated by gesture, including links to both '*bhāva*' and 'understanding'.

In the following chapters, the themes derived from this analysis of the interview material, together with others suggested by existing research and my own observations will be examined using three different analytical approaches, the first of which focuses on the relationship between musical pitch and hand position.

6 Musical Pitch, Hand Position, and Phrase Segmentation

6.1 Introduction

During the interviews discussed in the previous chapter, both teachers and students commented on the connection between teachers' hand gestures and features relating to musical pitch. This relationship was variously described as one in which hand gestures indicated 'movement', '*svaras*', and '*gamakas*', and was demonstrated by interviewees with high hand positions indicating higher pitches and lower hand positions indicating lower pitches (see sections 5.3.1 to 5.3.3). The positions at which musical pitches were indicated in space were not absolute, but rather relative to the pitch and hand position immediately preceding them (see section 5.3.2). Musicologists researching Indian vocal performance have previously noted the relationship between hand position and pitch (for example, Roy 1934, Clayton 2007, and Rahaim 2012). However, Rahaim (2012) raises the subject partly in order to question the extent and significance of this correspondence (pp. 37-46), issues that will be discussed later in this chapter.

As there have been no empirical studies published to date of the correspondence between hand position and musical pitch in the co-singing gestures of Indian vocalists, in this chapter I present an exploratory analysis along these lines in the context of Karnatak vocal lessons. As the analysis is exploratory in nature, one of the aims of this chapter is to reveal some of the problems encountered in using a quantitative approach to this subject. The analysis presented here is divided into two parts, the first using a quantitative approach, while the second draws more on qualitative methods. Both parts are based on data derived from videos of Karnatak vocal lessons recorded in the course of my research. My aims in this chapter are to assess the extent of mapping between pitch and hand position in lessons given by three different teachers, and to draw on video evidence to consider how such mapping may be useful in preventing and repairing student error. The theoretical basis for the analysis is derived from a combination of three different sources: the observations of musicologists researching Indian music, studies using experimental methodologies to examine cross-domain mapping between pitch movement and physical movement, and research on gesture in non-musical pedagogic contexts. These three areas of theory will be discussed in turn in the following three sections of this chapter.

6.2 Musical pitch and gesture in Indian music

Due to the lack of published research on gesture in Karnatak music performance, the literature referred to in this chapter discusses gesture in North Indian musical contexts. Examination of this literature suggests that although there may be some differences between gestures seen in the two traditions, their shared heritage and the numerous similarities observed mean that studies based in North Indian contexts can be considered relevant to the present study.

Correspondence between pitch and hand position in the gestures of North Indian vocalists has been noted by a number of musicologists. In an early reference to the phenomenon, Rabindra Lal Roy (1934) described the hand movements of Hindustani vocalists as follows:

> Observation shows that the singer describes with his hand apparently fantastic curves in space, by raising the hand with the rise of pitch and lowering it with the lowering of pitch. Sometimes, to avoid bad mannerisms, he makes forward and backward movements instead of upward and downward movements, but in any case the gestures underscore the movement of sound in the proper *direction.* (Roy 1934, p. 325)

By attributing the existence of 'forward and backward movements' to avoiding 'bad mannerisms' Roy ignored the potential for pitch to be mapped on to other axes, and also the possibility that musical qualities other than pitch may influence hand movement. However, his observations clarify that at least as far back as 1934, Indian vocalists tended to map hand position on to pitch position in the vertical axis.

In addition to his observation regarding pitch and hand position, Roy (1934) described Hindustani music as possessing an aesthetic of 'spatial movement', which he considered to be absent in 'European' styles. In his opinion, European musical styles are built from discrete notes, while Indian music is 'continuous' due to the slides and other connections between *svaras*:

> The continuous change [in Hindustani music] gives us the conception that the same musical tone is moving from place to place or varying in pitch, as related to a fundamental tone or given point of reference. Therefore the tones are not perceived as different entities, but the sensation is that of a single tone moving, leaving the impression of the path traversed. […] Thus in its ragas Hindustani music has essentially developed the aesthetic appeal of spatial movements. (Roy 1934, p. 326)

Roy's implication regarding gesture appears to be that the 'continuous' nature of Indian music provokes a heightened sense of movement through space, which is expressed through the performer's hand gestures.

Recent research on North Indian music and gesture has also contributed observations on the relationship between pitch and hand position. In an analysis of gesture in *khyāl* performance, Clayton (2007) observes that there is often a correspondence between the movement of the vocalist's hands and the pitch of the musical phrase, noting that at the start of one particular composition the rapid rise and fall of the melody is matched almost exactly by the contour of the vocalist's right hand movement (2007, p. 85). While Clayton is clearly not implying that all gestures show such a close mapping between hand position and pitch, his observations indicate that the mapping can often be seen in the style.

In his monograph on gesture in Hindustani vocal music, Rahaim (2012) discusses the relationship between musical pitch and hand position in some depth. He acknowledges that in some instances there is a correspondence between pitch movement and hand position. However, Rahaim's primary thesis is that gesture in Indian vocal performance is 'melody' in its broadest sense, and so he argues against what he considers to be a 'mechanical' or 'melographic' equating of gesture with pitch movement in the vertical axis (2012, p. 46). In support of this argument, he states that gestures do not simply map rising and lowering pitch on to analogous movements in the vertical axis, as suggested by Roy (1934). Instead, Rahaim observes that pitch may also be mapped to movement in the horizontal axis or even to the movement of the performer's hands in relation to each other (p. 38). Furthermore, he notes that other musical features may also be mapped by hand gestures, such as change in the vowel being sung, or variation in loudness (p. 42).

Although I agree with many of Rahaim's observations here, I argue that these qualifying factors do not preclude mapping between pitch and hand position from playing a significant role in musical communication and perhaps even in creativity in Indian music contexts. Instead of dismissing the relationship between pitch position and hand position as simplistic, I propose that it is worth examining the connection between the two in some detail, particularly in the present pedagogic context where spontaneous guidance on relative pitch in melodic movement may be extremely beneficial for the student. Considering that *gamakas* are not notated, and melodic movement is extremely subtle in the Karnatak style, any assistance towards replicating the teacher's phrases would appear to be helpful. Furthermore, beyond the communication of pitch information, mapping between pitch and hand position may also act as a scaffold upon which mappings with other musical qualities such as emphasis and articulation may be placed. Finally, the fact that so many teachers and students interviewed during the course of my research mentioned the relationship between hand

position and pitch related elements such as *svara* and *gamaka*, lends support to the importance of investigating the phenomenon further.

In exploring the relationship between pitch position and hand position, I am not suggesting that teachers make a deliberate effort to create spatial representations of pitch when demonstrating phrases to their students. Although when questioned on the subject of gesture, teachers do mention the relationship between *svara* and hand position, they also emphasise that their gestures are 'automatic' and occur without their 'knowledge' (TS, Bangalore, personal interviews, January 4 and August 11, 2014 – see section 5.2). It appears, therefore, that teachers do not make a deliberate effort to trace pitch in space, but rather that this sometimes occurs spontaneously. Furthermore, in the analysis that follows, it will be seen that teachers' gestures often precede corresponding pitch movements by between 100 and 300ms, which suggests that teachers are not deliberately translating sung phrase into gestural movement after the fact. The gestures should, therefore, be considered spontaneous movements, with the tendency to produce them most likely developing as a result of long-term exposure to their own teachers' gestures over many years of face-to-face contact while learning. However, that these gesturing habits are spontaneous does not preclude them from contributing to the transmission of musical details, and also does not preclude the majority of musicians from being aware of this fact.

The spontaneity of the gestures discussed here makes them interesting beyond the study of Indian music and relevant also to the field of music cognition where they would be considered as evidence of cross-domain mapping between pitch and hand position in a real musical context. As the gestures are not part of a codified system, as exists, for example, in chironomy,[34] and are also not a deliberate attempt to trace musical pitch in space while singing, any spontaneous mapping between pitch and hand position seen here should be considered strong evidence of cross-domain mapping between musical and spatial/motoric parameters. While there have been no previous empirical studies of cross-domain mapping between pitch and physical motion in a real musical context, there have been many studies in which experimental methodologies have been used to explore this relationship in controlled conditions. Some of these will be discussed here and used to generate hypotheses for the analysis that follows later in this chapter.

[34] Some readers may see parallels between the hand gestures in this context and chironomy in ancient and early church music. While there are similarities, such as the heavy presence of hand gesturing in a musical style that makes little use of notation, there is no evidence to suggest that the gestures seen in Indian contexts were ever an explicitly codified pedagogic system. Therefore, the two types of gesturing must be considered distinct.

6.3 Cross-domain mapping

Falling within the field of research on perceptual cross-modality or multimodality, cross-domain mapping refers to the tendency for people to make consistent correspondences between change in one modality and change in another. Examples of cross-domain mappings in which auditory stimuli are involved include correspondences between loudness and visual size, auditory pitch and visual size, auditory pitch and brightness/shininess, and auditory pitch and spatial position (for an overview of such research, see Spence 2011). As the topic of cross-domain mapping between auditory pitch and position in space is highly relevant to the research questions asked in this chapter, I will present a discussion of existing research on the subject in the sections that follow.

6.3.1 Mapping between pitch and spatial position

The mapping between auditory pitch and spatial position has been extensively studied using a variety of experiment-based methodologies. One of the longest standing methods used is that of forced-choice matching, wherein participants are asked to choose which of a given set of responses provide the best match to the sonic stimulus presented. This method has been used in studies asking test subjects to match different acoustic parameters of simple musical tones with abstract visual figures (Walker 1987), and to match more complex musical stimuli with pictures (Cowles 1935; Karwoski et al. 1942). In a variation of this forced-choice matching method, Eitan and Granot (2006) asked participants to visualise an animated human character in response to musical stimuli of brief melodic figures, and then to choose from a list of motion and spatial qualities to describe their character's movement. Amongst many correspondences found in the study was a significant correlation between direction of pitch movement and direction of the character's movement, not only in the vertical axis, but also in the lateral axis and in depth (2006, pp. 232-233).

Speeded classification is another technique used to test for cross-domain mapping. Ben-Artzi and Marks (1995) employed this approach, asking participants to define whether an auditory pitch is high or low while seeing images in which the spatial position of an object is either high or low. They found that participants responded more slowly when the spatial position of an object was incongruent with the mapping, for example a low tone with a high position in space, than when it was congruent, for example a high tone with a high position in space. The results were interpreted as evidence of a cross-modal relationship between the two domains in the perception of the participants, with high pitch position corresponding to high spatial position.

More recently, several studies have used a free-motion response method, in which participants are asked to respond to musical phrases with physical movement, either drawing

on tablets or moving in free space. In Godøy et al. (2006), participants were asked to respond to musical and environmental sounds of between two and six seconds in length by drawing shapes on a tablet. This study found cross-domain correspondences for sounds that had relatively unambiguous envelopes in overall energy or pitch, but more divergence among sounds with more complex timbral and textual content. In another study using a real-time drawing paradigm, Küssner (2014) compared musically trained and untrained subjects, and found that the musically trained subjects were more likely to represent pitch as height and pressure/thickness as loudness than those who were musically untrained (pp. 74-75). In a separate experiment (Küssner et al. 2014), subjects were asked to represent musical stimuli with free movement of their right hand whilst being recorded on a motion-capture system. Here it was found that the movements of both musically trained and untrained participants were positively correlated with musical pitch, but that the correlation coefficients were higher for the musically trained group (Küssner et al. 2014, p. 10). In another free-motion response study, Caramiaux et al. (2010) asked test subjects to respond to short musical phrases with hand movements recorded with a motion-capture system. Here, pitch was not tested for, but it was found that hand position, velocity, and acceleration were pertinent in accounting for loudness and sharpness in the musical phrases.

All of the studies discussed above in which the relationship between pitch motion and movement in space was explored found significant correlations between high pitch and high spatial position. Furthermore, Eitan and Granot (2006) found positive correlation between pitch movement and physical movement in all three axes. These existing results will be as the basis one of the hypotheses posed in the present study.

6.3.2 Cross-domain mapping in face and head movements

It is not only hand movements that have been found to correlate with pitch motion. When singing wide intervals, the upward movements of vocalists' eyebrows tend to correspond with upward pitch movements (Thompson and Russo 2007). Related correspondences also occur in non-musical contexts. In natural speech, the head movements of the speaker have been found to correlate to auditory pitch produced (Yehia et al. 2002; Munhall et al. 2004). Furthermore, Munhall et al. (2004) find that such natural head motion improves auditory speech perception in listeners, and suggest that segmentation cues provided in such motion are the likely cause of this improvement. In another study on spoken pitch and head motion, Smith and Strader (2014) found that the head movements of mothers showed a higher correlation with pitch when their speech was directed towards infants compared to when it was directed towards adults. These studies present two points relevant to the present context. The first is that even in speech, head motion tends to correlate with pitch movement; this

suggests that the connection between pitch height and vertical height is highly integrated in human action and perception, and so is likely to also show itself in musical contexts. Secondly, the findings in Smith and Strader (2014) show that correlation between pitch and head movement varies dependent upon the communicative context. It seems possible, therefore, that the spontaneous head and hand movements made by teachers in Karnatak vocal lessons may vary in the extent to which they correlate with pitch depending on the pedagogic context. Although it is beyond the scope of this study to examine the head movements of vocal teachers, in the analyses that follow I will explore whether correlation between teachers' hand movements and musical pitch increases following student errors.

6.3.3 Origins of cross-domain mapping

The reasons for the existence of cross-domain mapping between auditory pitch and spatial height are still debated, as is the extent to which the mapping is found across different cultures. The various explanations suggested for this mapping are as follows: that it is an innate tendency (Walker et al. 2010), that it is a learned association stemming from our earliest physical interactions with the world (Dolscheid et al. 2013), and finally that it is a culturally specific learned association resulting from factors such as the use of verbal metaphors and the physical layout of musical instruments played (Ashley 2004). Learned associations between pitch and spatial height due to physical interaction with the world include our own experiences of producing sound, such as the tendency for the larynx to move upwards as we sing higher pitches and downwards as we sing lower pitches (Honda et al. 1999), and also for lower notes to resonate in the chest, while higher notes appear to resonate more in the head (Zbikowski 1997, pp. 202-203). Early-learnt mappings between pitch and height have also been suggested as arising due to underlying visuospatial representations (Dolscheid et al. 2014), perhaps caused by pinna-based frequency-elevation associations (Eitan et al. 2012, pp. 42-43).

However, it appears that mapping between auditory pitch and height is not universal across different cultures, and that factors such as verbal metaphor and musical practices are implicated in the formation of cross-domain mapping (Shayan et al. 2014, Ashley 2004, Antovic 2009, Walker 1987). Nevertheless, as studies have shown that children as young as two months old show evidence of the mapping between pitch and spatial height (Walker et al. 2010), it is apparent that this mapping cannot be learned purely through verbal metaphor or musical practices. Considering the range of evidence, it seems probable that cross-domain mapping between pitch and spatial height stems from a combination of innate and early-learnt factors, and that this mapping may be either reduced or reinforced through culturally specific influences such as verbal metaphors and musical practices (Dolscheid et al. 2013, p. 619,

Spence 2011, Lidji et al. 2007, Shayan et al. 2014). The physical layout of an instrument practiced for many years has been proposed to affect individual musicians' tendencies to map between domains (Lidji et al. 2007). This factor might influence the extent of cross-domain mapping found in individual musicians even within what might be considered a single culture.

6.4 Gesture in non-musical pedagogic contexts

A third area of literature relevant to the present study is that which explores the role played by gesture in pedagogic contexts beyond music. There have been a number of studies examining gestural interaction in mathematics lessons, focusing on teachers' use of gesture to scaffold student understanding and resolve 'trouble spots' (Alibali and Nathan 2007, 2012; Alibali et al. 2013, 2014). 'Trouble spots' are interactions in which students display lack of understanding. Alibali et al. (2013) view such trouble spots as indicators that shared understanding, or 'common ground', between teacher and students has been lost, acting as an invitation for the teacher to try other means to establish this commonality (p. 427). Both trouble spots and loss of common ground can be seen to occur frequently in Karnatak vocal lessons. If the student fails to correctly imitate one of the teacher's phrases, the teacher must then repeat the phrase in a way that helps the student correct their error. To do this, the teacher must ensure that the necessary common ground exists for the student to understand where the error occurred and how to resolve it.

Alibali et al. (2013) found in their analysis that teachers increased their use of gesture immediately following trouble spots in a way that created common ground between teachers and students. In this chapter, I draw on such research by asking whether changes in Karnatak vocal teachers' gestures can be observed following trouble spots in lessons.

6.5 Quantitative analysis of mapping

6.5.1 Aims and hypotheses

The research undertaken here is an exploratory study of cross-domain mapping in a real musical context, based on three case studies. As such, no conclusions regarding the wider population of Karnatak vocal teachers can be drawn from the findings. The study is the first to use quantitative methods to examine cross-domain mapping between hand gestures and melodic movement in Indian vocal teaching, and so acts also as an investigation of the difficulties involved in using such an approach. The chapter aims first to assess the extent of correspondence between auditory pitch and co-occurring hand position in musical phrases

performed by Karnatak vocal teachers in three lessons. This is an attempt to explore the relationship between auditory pitch and spatial position in a real musical context, as opposed to the experiment-based approaches more normally used to study cross-domain mapping. The second aim of this chapter is to consider how such mapping may contribute towards the repair of student error during lesson trouble spots.

In order to examine the extent of cross-domain mapping between pitch and hand position using quantitative methods, the following three hypotheses are tested:

1) Mapping between musical pitch and hand position of teachers' gestures will be found both in the vertical and horizontal axes.
2) Individual teachers will differ in the extent to which their gestures show mapping between pitch and hand position.
3) Gestures produced by teachers while singing phrases to correct student error will show a stronger mapping between pitch and hand position than gestures produced while singing initial demonstration phrases.

The first hypothesis proposing that mapping will be apparent not only in the vertical axis but also in the horizontal axis, draws on observations by Rahaim (2012) and also findings from (Eitan and Granot 2006) (see section 6.3.1). The second hypothesis, that individual teachers will differ in the extent to which their gestures map pitch position, is derived from Rahaim's (2012) observation of a wide range of individual gesture styles, and also on findings from Lidji et al. (2007) on the influence of past musical experience on individuals' tendency to map between domains. The final hypothesis, regarding gestural difference between demonstration and correction phrases, draws on Alibali et al. (2013), in which gesture rate was found to change following lesson trouble spots.

While these three hypotheses will be tested using quantitative methods, the final section of this chapter will explore cross-domain mapping in lessons using qualitative approaches. Here I will first examine the manner in which pitch is mapped to hand movement and discuss how this varies in the gestures of different teachers. Finally, I will draw on video evidence from lessons to consider the role played by gestural cross-domain mapping in preventing and correcting student error.

6.5.2 Initial methods: recording and coding

Initial descriptions of the recording of interviews and lessons undertaken in the course of my research have been given in sections 4.3 and 5.2 of this thesis. The lessons were recorded on two video cameras, one facing the teacher and the other facing the student. Recordings were

made in the teachers' homes, as this is where the lessons normally took place. During lessons, teacher and student typically sat cross-legged on the floor on mats facing each other, or with the teacher sitting on a chair and the student sitting on the floor.[35] The video was recorded at 50fps to facilitate subsequent motion-tracking from video.[36] Audio was recorded on a Zoom H4N placed between teacher and student as well as on microphones positioned on the video cameras. On returning to the UK I combined the images from each camera to make a single split-screen video of each lesson showing the teacher on one side of the frame and the student on the other.

Three lessons given by different teachers were chosen from the total number recorded as described in section 4.3 of this thesis. The three teachers whose lessons and gestures will be discussed here are Suguna Varadachari (hereafter SV), T.V. Ramanujacharlu (hereafter TKV), and T.S. Sathyavathi (hereafter TS). The split-screen videos of these three teachers' lessons were imported into *ELAN* video annotation software for coding (Lausberg and Sloetjes 2009). Here, the pedagogic interaction between teacher and student was coded as seen in Table 6.1, which shows the various stages in both the 'teacher demonstration model' and 'student presentation model' of *rāga ālāpana* teaching discussed in section 4.5 of this thesis. When lessons followed the teacher demonstration model, the teacher's first demonstration of a phrase was coded as 'demonstration', and the student's initial attempt to imitate a phrase was coded as 'imitation'. If the teacher chose to repeat a phrase due to student error this was coded as 'correction', and the student's attempt to improve their imitation was coded as 'adjustment'. When the lesson followed the student presentation model, initial phrases sung by the student were coded as 'suggestion'. If the teacher interrupted the student's flow to make a suggestion the phrase was coded as 'demonstration of a preferred phrase', and when the teacher interrupted to correct an error phrase this was coded as 'correction'. Phrases sung by the student in response to the teacher's demonstration phrases in this model were coded as they were in the teacher demonstration model. Coding entire lessons in this way made it easy to locate the number and location of each type of phrase, and to create a global picture of pedagogic interaction in each lesson.

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[35] In India, it is considered respectful for a student to sit on the floor in front of his or her teacher.

[36] Video tracking was chosen for this research over alternatives such as optical motion-capture because of the physically intrusive nature of motion-capture techniques, wherein multiple cameras must be set up and markers placed on the performer's body, along with restrictions on dress (typically relatively tight black clothing must be worn). Such methods were not suitable for the present research, as they would have alerted the participants to the significance of their movements, thus possibly distorting the results by making the vocalists self-conscious about their gestures. In addition, the senior performers whose lessons I wished to record would have been highly unlikely to be willing to suffer the physical intrusiveness and time consuming nature of motion-capture sessions.

	Codes used in the teacher demonstration model	Codes used in the student presentation model
Student: own phrase	N/A	Suggestion
Teacher: initial demonstration of a phrase	Demonstration	Demonstration of a preferred phrase
Student: first attempt to imitate the phrase	Imitation	Imitation
Teacher: attempts to correct student error	Correction	Correction
Student: attempts to rectify their error	Adjustment	Adjustment

Table 6.1: Terms used in coding the pedagogic flow of the lesson for the two different lesson models commonly used in teaching *rāga ālāpana*.

As teachers and students sit while singing, they tend to rest their hands either on their knees or in their laps between phrases. Co-singing gestures typically begin just before the phrase starts with the hand being lifted from the knee, and often end just before the phrase is completed with the hand returning to the knee. As will be seen in the analysis that follows, there is a tendency for gestures in this context to run slightly ahead of the musical features with which they correspond.

6.5.3 Results of the initial coding of pedagogic interaction

Co-singing gestures were present in 98% of all phrases sung by teachers, and were usually continuous throughout phrases. Students also gestured while singing, with 96% of their sung phrases accompanied by hand gestures. However, in comparison with the gestures produced by teachers, students' gestures tended to be smaller in magnitude, less continuous throughout phrases, and stayed closer to the hand's resting place on the knee.

A breakdown of each lesson with the number of phrases sung by the teacher, and number of trouble spots occurring is given in Table 6.2. Trouble spots are defined as points in the lesson where the student makes an error and the teacher gives at least one correction in an attempt to repair the error. Trouble spots are fewer in number than corrections, as teachers often made more than one correction for the same phrase. Looking at Table 6.2, it may appear as though the lessons are rather short. Typically a Karnatak vocal lesson may comprise tuition of a composition, followed by some tuition in *rāga ālāpana* or another improvisational format (see section 4.5). As I am only concerned in this chapter with *rāga ālāpana* tuition, the sessions analysed here represent only part of a typical lesson.

Teacher	Length of lesson	Total phrases	Demonstration phrases	Correction phrases	Trouble spots
SV	16 min	87	55	32	17
TKV	19 min	172	91	81	30
TS	19 min	168	132	36	22

Table 6.2: Breakdown of each teacher's lesson according to phrase type and number of trouble spots.

The lesson given by SV shows markedly fewer phrases sung by the teacher for three reasons: firstly, much of the lesson followed the student presentation model and so consisted of many student suggested phrases; secondly, the teacher tended to demonstrate longer phrases than those given by the other two teachers; and lastly, this lesson section was somewhat shorter than the others. The proportion of correction to demonstration phrases differs in each of the three lessons. TS gives the fewest corrections, while TKV provides the most. This may be due to their respective students' level of proficiency as TKV's student was the least experienced of the three, perhaps leading to more trouble spots in the lesson and more correction phrases required. However, the differences in proportion of phrase types seen here may simply reflect the pedagogic approach of each teacher.

6.5.4 Subsequent methods: video tracking and correlation

Following coding of pedagogic interaction in the three lessons, steps were taken to assess correlation between hand position and pitch position in each lesson. It was necessary to do this on a phrase-by-phrase basis rather than for the entire lesson as a whole, as only the gestures made while singing were relevant to the research questions posed. As the methods used in this part of the analysis were extremely time consuming, I opted to randomly choose 40 phrases from each lesson for analysis, of which 20 were demonstration phrases and 20 were correction phrases. Each randomly chosen phrase was edited from the lesson and made into a separate movie file. The length of phrases ranged from between one and ten seconds. Each phrase was imported into *After Effects*, a commercial visual effects software package that includes both automatic and manual tracking functions. Here the hand movements of each teacher were tracked using customised settings, providing pixel coordinates for the centre of the hand at each frame of the video (50 frames per second). In the few instances where teachers used two-handed gestures, the hand that appeared dominant, displaying the most motion, was tracked. The majority of gestures produced by all three teachers were

performed by the right hand alone, although SV gestured solely with her left hand for part of her lesson. Tracking was monitored throughout the process and checked for accuracy. In some cases the automatic tracking failed to follow the teacher's hand, due either to speed of movement or lack of visual separation between the hand and background. For these segments, hand movement was tracked manually.

Pitch data were obtained as fundamental frequency of the audio using the Matlab *SWIPE* function developed by Camacho (2007). This was embedded in a custom Matlab script that also calculated correlation between the pitch data and the position coordinates of the hand in the x and y-axes.[37] Spearman's rank correlation was chosen as preferable, for its tendency to control for autocorrelation and the resulting inflation of correlation coefficients in time-series data (see Schubert 2002, p. 225; also Vines et al. 2006, p.88). Küssner (2014) discusses at length the problems involved in correlating time-series data and notes that while we should be cautious in interpreting the significance value of non-parametric correlation coefficients, it is acceptable to compare correlation coefficients with one another if they come from the same source (2014, pp. 57-59). Therefore, in the analyses that follow I will use Spearman's rank correlation and report the coefficient values for the different states tested so that they may be compared with each other. Significance values will not be given, as they are potentially misleading in this context. As suggested in Swinscow and Campbell (2002) correlation between 0-0.19 will be described as very weak, 0.2-0.39 as weak, 0.40-0.59 as moderate, 0.6-0.79 as strong and 0.8-1 as very strong, and emphasis will be placed on the context of results rather than the absolute figures derived (2002, p. 78).

In the present study each of the 120 total phrases (40 from each teacher) were tested for correlation between pitch and hand position using Spearman's rank correlation, calculated separately for the x and y-axes in order to assess the extent of mapping in each. Mean correlation coefficients were then calculated to assess overall mapping in each axis, and also to compare mapping seen in the gestures of different teachers, and in each type of phrase (demonstration or correction).

6.5.5 Results

The results of the test for each hypothesis will be given here, followed by a discussion of the overall findings.

Hypothesis 1

[37] This custom Matlab script was developed from existing scripts kindly contributed by Dr Kristian Nymoen and Mari Romarheim Haugen at Oslo University.

- Mapping between musical pitch and hand position of teachers' gestures will be found both in the vertical and horizontal axes.

In order to test this hypothesis, the mean correlation between pitch and hand position of all 120 phrases (40 from each teacher) was calculated for both the x and y-axes.[38] Correlation was first calculated as a mapping between pitch and hand position in which high pitch corresponds to high hand position in the vertical axis (y-axis). In order to provide an equivalent test in the x-axis, correspondence between high pitch and the right side of the body was calculated in this case. The choice of the right side of the body was influenced by the finding in Eitan and Granot (2006) of a significant correlation between falling pitch and movement to the left (p. 232). The term 'one-to-one' mapping is used here for mapping in which only one direction is considered positive (for example, high pitch to high hand position).

The results from this analysis are presented in Table 6.3, where it can be seen that although the global correlation values for all three teachers combined are positive in both axes, the relationship in each case is rather weak. Correlation between pitch and hand position was stronger in the y-axis (r = 0.30) than in the x-axis (r = 0.10).

	Mean correlation coefficient of all three teachers combined
Y-axis (high pitch to high hand position)	0.30
X-axis (high pitch to right side of body)	0.10

Table 6.3: Mean correlation in one-to-one mapping between pitch and hand position for all three teachers combined. Correlation in the y-axis is stronger than in the x-axis.

In addition to this one-to-one mapping, a direction-agnostic condition was also examined in which correlation in both directions of each axis was considered positive (see Table 6.4). This allowed for the possibility that some phrases may show mapping between high pitch and high hand position while others may show mapping between low pitch and high hand position.

[38] I tested 20 randomly chosen correction phrases and 20 randomly chosen demonstration phrases from each teacher. However, as the teachers produced more demonstration phrases than correction phrases (see Table 6.2), in the tests for hypotheses 1 and 2, I adjusted for this unevenness by weighting the results from each type of phrase (demonstration and correction) according to their respective proportions of total numbers of phrases in each lesson.

	Mean correlation coefficient of all three teachers combined
Y-axis (mapping in either direction)	0.42
X-axis (mapping in either direction)	0.35

Table 6.4: Mean correlation direction-agnostic mapping between pitch and hand position. Correlation in either direction of each axis is considered positive.

In the direction-agnostic condition, the mean correlation coefficients are more robust, with the y-axis correlation being moderate in strength (r = 0.42). In this condition, the correlation in the y-axis (r = 0.42) is only slightly stronger than that in the x-axis (r = 0.35).

In summary, the hypothesis that musical pitch will map to hand position in both the x and y-axes is found to be the case, although correlation tends to be somewhat stronger in the y-axis than in the x-axis. Correlations found ranged from very weak to moderate in strength. Further insight into the relationship between pitch and hand position in this context can be gleaned through the results of the following test looking at individual teachers' gestures.

Hypothesis 2

- Individual teachers will differ in the extent to which their gestures show mapping between pitch and hand position.

When the mean correlation coefficients of each individual teacher are compared (see Table 6.5), one of the factors contributing to the weak global correlation in the y-axis one-to-one mapping condition can be seen; the gestures of one teacher, TKV show a far lower degree of mapping between pitch and hand position in the vertical axis (r = 0.10) than the other two teachers (r = 0.46 and r = 0.35), reducing the global average of all three combined (r = 0.30).

	SV	TS	TKV
Y-axis (high pitch to high hand position)	0.46	0.35	0.10
X-axis (high pitch to right side of body)	0.24	-0.10	0.16

Table 6.5: Mean correlation in one-to-one mapping between pitch and hand position for each teacher. There is a large degree of variance between the three teachers' mean correlations.

However, the mean correlation coefficients for the direction-agnostic condition show a somewhat different situation (see Table 6.6). Here, the correlations found in TKV's gestures

are stronger than was the case in the one-to-one mapping condition, and the variation between teachers is greatly reduced. This suggests that TKV's gestures are linked to pitch movement in both directions of both axes, but do not show the degree of correspondence between hand height and pitch height seen in the gestures of the other two teachers.

	SV	TS	TKV
Y-axis (mapping in either direction)	0.49	0.42	0.35
X-axis (mapping in either direction)	0.37	0.37	0.32

Table 6.6: Direction-agnostic mapping between pitch and hand position for each teacher, in which correlation in either direction of each axis is considered positive.

In summary, the results here confirm the second hypothesis of this study, demonstrating that individual teachers differ in the extent to which their gestures map pitch movement. TKV has a quantifiably different gesture style, in which there is very little correspondence between pitch height and hand height, but where mapping occurs more generally in both directions of both axes. SV's gestures stand out as showing the strongest correlation of the three teachers between high pitch and high hand position (see Table 6.5).

One possible explanation for TKV's distinct gesture style may lie in the fact that he is primarily a violinist, with vocal performance and teaching playing a secondary role in his professional life. In Karnatak music, it is not unusual for performers to both play an instrument and sing, as it is considered beneficial for instrumentalists to sing and for vocalists to learn an instrument. It is possible that when such musical activities are pursued for many years, the bodily practices of instrumental performance may have an impact on co-singing gestures. TKV's gestures often show a sweeping motion in the horizontal axis, and it seems possible that there is some influence here from the sweeping motions of violin bowing to which he is so accustomed.

Hypothesis 3

- Gestures produced by teachers while singing phrases to correct student error will show a stronger mapping between pitch and hand position than gestures produced while singing initial demonstration phrases

In order to test this hypothesis, 20 demonstration phrases and 20 correction phrases were randomly chosen from each lesson (120 phrases in total), and the mean correlation

coefficients for demonstration and correction phrases were compared. The results of this comparison looking at mapping in the y-axis between high pitch and high hand position can be seen in Table 6.7. Overall correlation is slightly stronger in the correction phrases (r = 0.36) compared to the demonstration phrases (r = 0.28) for all three teachers combined. This global result is largely derived from the lessons given by SV and TS, as TKV's gestures do not show stronger correlations in correction phrases. The combined results were similar for the x-axis, direction-agnostic version of the same test (see Table 6.8), with only a slightly stronger correlation in correction (r = 0.38) as compared to demonstration (r = 0.34) phrases.

	SV	TS	TKV	Combined
Demonstration Y-axis (high pitch to high hand position)	0.43	0.32	0.10	0.28
Correction Y-axis (high pitch to high hand position)	0.51	0.44	0.10	0.36

Table 6.7: Comparison of demonstration and correction phrases, looking at mapping in the y-axis between high pitch and high hand position. Global mapping for all three teachers combined is slightly stronger in the correction phrases compared to the demonstration phrases.

	SV	TS	TKV	Combined
Demonstration X-axis (mapping in either direction)	0.39	0.36	0.28	0.34
Correction X-axis (mapping in either direction)	0.34	0.43	0.36	0.38

Table 6.8: Comparison of demonstration and correction phrases, looking at mapping in the x-axis with direction treated agnostically (mapping in both directions of the axis considered positive). Global mapping for all three teachers combined is slightly stronger in the correction phrases compared to the demonstration phrases.

In summary, in the lessons analysed correction phrases were only slightly stronger in their mapping between pitch and hand position than demonstration phrases. This tendency was stronger in the y-axis than in the x-axis, and stronger in some teachers than in others. As the difference in the strength of correlation was extremely small, the results cannot be said to support the hypothesis posed.

6.5.6 Correlations in individual phrases

The range of correlation coefficients found between pitch position and hand position in individual phrases was large, ranging from very strong (r = 0.92) to very weak (r = 0.01), and phrases often showed a strong correlation in one axis but low correlation in the other. Different phrases sung by the same teacher also showed a wide degree of variation in strength of correlation. Furthermore, the way in which pitch and hand position were coupled changed from phrase to phrase; for example, one phrase sung by a teacher might show a mapping in the x-axis, while the next phrase might show a mapping in the y-axis, but not in the x-axis. These findings are similar in some respects to those in Yehia et al. (2002), which examined the relationship between auditory pitch and head movement during speech. This study found that a high degree of variance in auditory pitch could be accounted for by a combination of six estimators of head motion (three rotations and three translations). However, the manner in which pitch and head motion was coupled changed from utterance to utterance, so that if only one type of coupling was tested for across all sentences analysed, the positive correlation disappeared for the corpus as a whole (p. 565). For example, in one sentence tested, pitch is coupled more with head movement in the x-axis when spoken the first time, but when spoken on another occasion pitch is coupled more with movement in the y-axis (Yehia et al. 2002, p. 566). Similarly, in the Karnatak vocal lessons explored here, the way in which pitch and hand motion is mapped changes from phrase to phrase: sometimes stronger in one axis, sometimes stronger in the other. However, the findings here differ from those of Yehia et al. (2002) in that when only one axis is examined for all examples in the corpus, correlation does not disappear - although it does become weak.

While the majority of phrases analysed in this study showed moderate to strong correlation in either both or at least one axis, in approximately a third of phrases correlation was weak (r = < 0.4) in both axes, and showed no clear relationship between pitch movement and hand movement. Possible reasons for this lack of correlation in a large subset of phrases, and also the generally wide variation of correlations observed across individual phrases will be discussed further as this chapter progresses.

6.5.7 Discussion of results

Looking at the results, it might be noted that the mean correlations between pitch and hand position are relatively weak compared to those found in experiment-based studies where participants are asked to represent simple melodic stimuli using hand motions. For example, in Küssner (2014), participants were asked to first listen to a short phrase and then represent

the sound visually using a stylus on a graphics tablet during the second playing of the phrase. Here, mean correlation coefficients between pitch and vertical height were r = 0.74 for musically trained participants and r = 0.55 for musically untrained participants (2014, p. 80). There are several comments to be made regarding the comparatively weak correlations found in the present study. First, in this study, cross-domain mapping is explored in a real musical context in which participants have not been asked to represent the music with hand gestures. The gestures are simply occurring spontaneously, without any deliberate attempt to match them to the music. Therefore, the correlations observed, although only low to medium in strength, should be considered noteworthy. Secondly, correlations in individual phrases range from very high (0.92) to very low (0.01). This raises the possibility that the degree of mapping might depend to some extent on the immediate pedagogic context: on whether, for example, the teacher is focusing on pitch, or instead on some other musical feature, such as emphasis. Thirdly, there are several characteristics inherent in the material analysed that tend to lower correlation in many phrases. These characteristics will be considered here with examples given of each.

1) Hand positioning movements

Vocalists typically lift their hand from their lap or knee just before they start to sing a phrase, and place it down again just before the phrase ends. Often the hand is returned to the knee while the vocalist is still singing a sustained pitch at the end of the phrase. When this occurs, this moment of incongruence, with the pitch held steady and the hand descending to the knee, weakens the correlation for the phrase as a whole, even though the hand movement is simply a positioning movement that has no relation to the melodic content of the phrase. An example of the way in which such positioning movements can weaken the overall correlation between pitch and hand position in a phrase can be seen in Figure 6.1 (Media File 6.1).

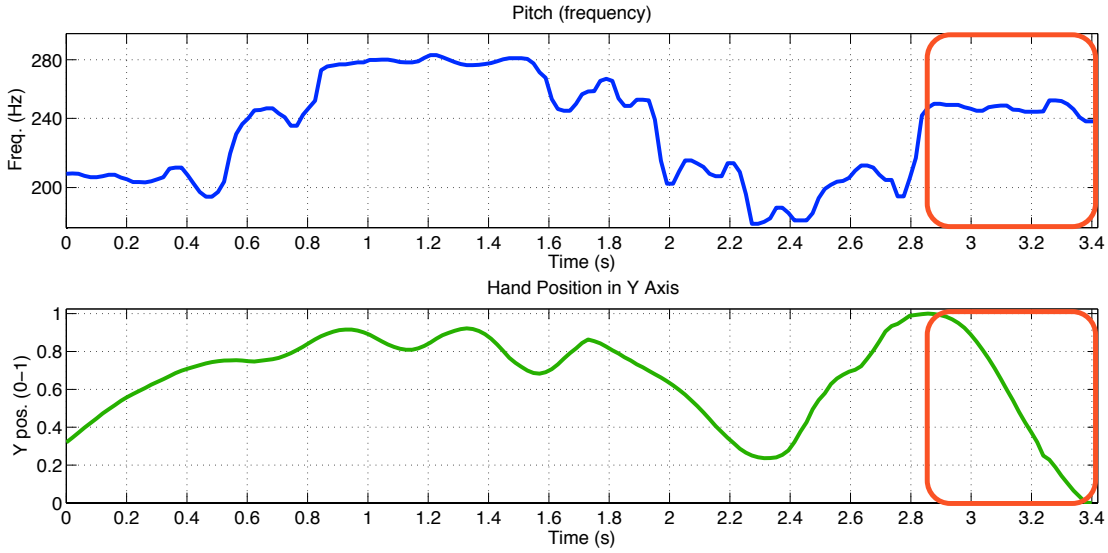

Figure 6.1: SV correction phrase 5 (see Media File 6.1). This figure shows pitch movement (blue line) plotted above hand position in the y-axis (green line). The red boxes highlight the part of the phrase lowering overall correlation. The phrase ends on a prolonged pitch (with some oscillation); however the hand, after rising to match the upward pitch movement from 2.4-2.8 seconds, immediately drops back down to the teacher's lap.

Here, pitch and hand position in the y-axis can be seen for a correction phrase sung by SV (Figure 6.1). Although the hand movement broadly maps the pitch movement, the y-axis correlation coefficient (high pitch to high hand position) for the phrase as a whole is only r = 0.54, partly due to the hand falling at the end of the phrase while the last *svara* is still being sung. Although this scenario occurs frequently, it is not present in every phrase, so controlling for the influence of this phenomenon is not straightforward.

2) Gestures occur ahead of melodic movement

Observation of position and pitch data shows that the hand gestures often occur ahead of corresponding melodic motion. This offset can be as much as 300ms, although it is not the same throughout. Therefore, it is impossible to correct for this simply by offsetting the movement data when calculating correlations. A typical example of the offset can be seen in Figure 6.2 (Media File 6.2), where the first upward hand movement (occurring just before 0.5 seconds into the phrase) precedes the corresponding pitch leap by approximately 50ms. Later in the same phrase, the downward hand motion at 1 to 1.1 seconds precedes the corresponding downward pitch movement by over 200ms. Such offsets will tend to reduce the overall correlation coefficient of the phrase.

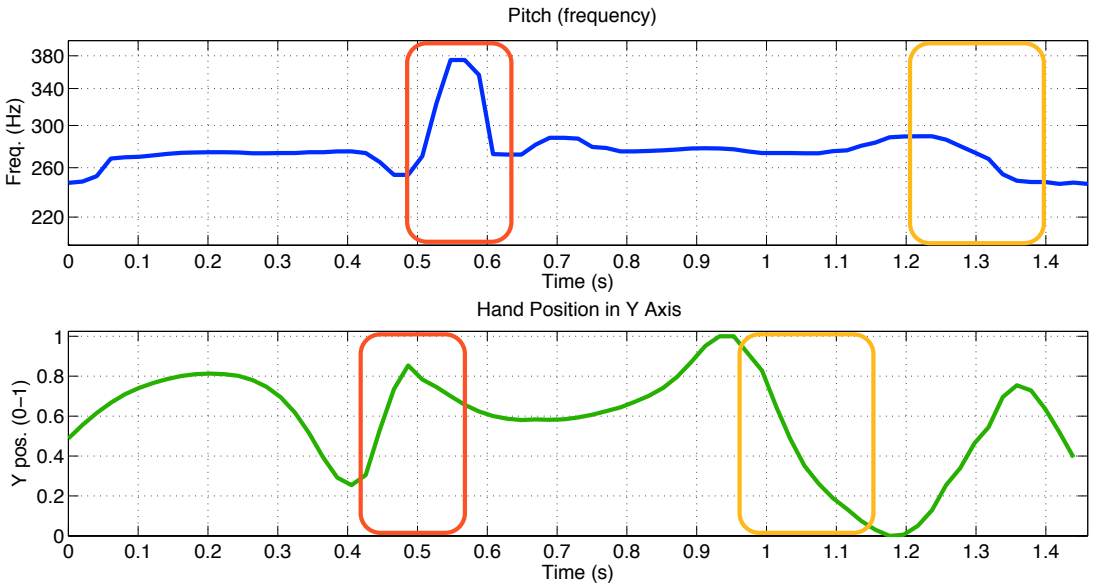

Figure 6.2: SV correction phrase 11 (Media File 6.2). This figure shows pitch movement (blue line) plotted above hand position in the y-axis (green line). The red and yellow boxes highlight the way in which hand movements precede corresponding pitch movement. The upward motion in hand position 0.5 seconds into the phrase occurs 50ms before the corresponding upward pitch movement. Similarly, the downward hand movement from 1 to 1.1 seconds into the phrase occurs more than 200ms ahead of the corresponding downward pitch movement.

This offset may also be viewed by looking at the derivatives of pitch and hand position. These are presented in Figure 6.3 (Media File 6.3) for another phrase performed by SV, demonstrating the way in which change in hand position (peaks in velocity shown by the orange line) often precedes change in pitch position (peaks in change in pitch shown by the purple line).

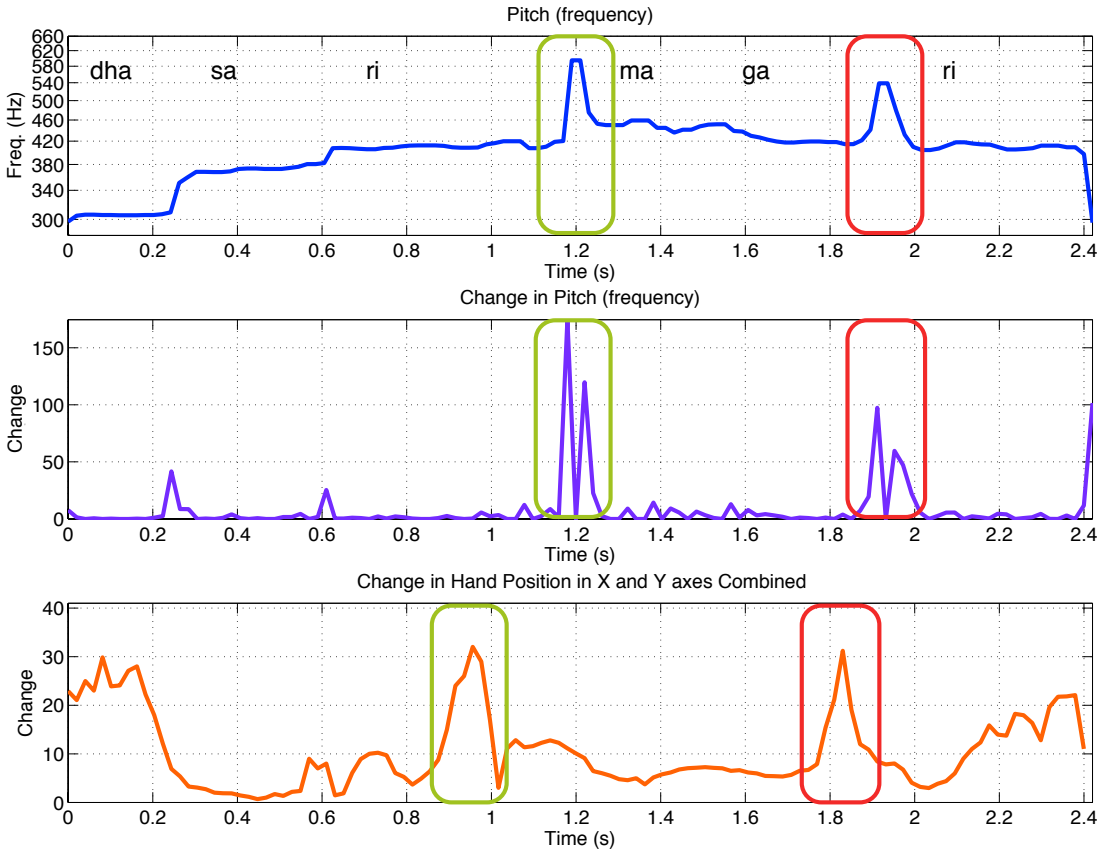

Figure 6.3: SV correction phrase 21 (Media File 6.3). This figure shows pitch movement (blue line) plotted above change in pitch (purple line), and change in hand position in x and y-axes combined (orange line). The green and red boxes highlight the offset between change in pitch and change in hand position, with the change in hand position preceding change in pitch by between 50 and 250ms.

Here the hand motion highlighted by the green box occurs approximately 250ms before the corresponding pitch movement, while the following peak in hand motion, highlighted by the red box, occurs only 50ms before the related pitch movement. Similar offsets are found throughout the lessons in the gestures of all three teachers, where they tend to weaken correlation between pitch position and hand position in a manner that is not predictable due to variation in the extent of the offsets.

3) Mapping in different axes within phrases

The third characteristic inherent in the material that acts to reduce overall correlation in each axis is that different parts of the same phrase may be mapped on to different axes. For example, in Figure 6.4 (Media File 6.4) the, initial gradual upward pitch movement of SV's phrase is mapped by an upward hand movement. However, the remainder of the phrase is not mapped in the same axis. Instead, the upward leap in pitch position that occurs just after 1 second into the phrase is mapped in a sudden lateral hand motion in the x-axis (marked by the yellow box in the lowest plot of Figure 6.4).

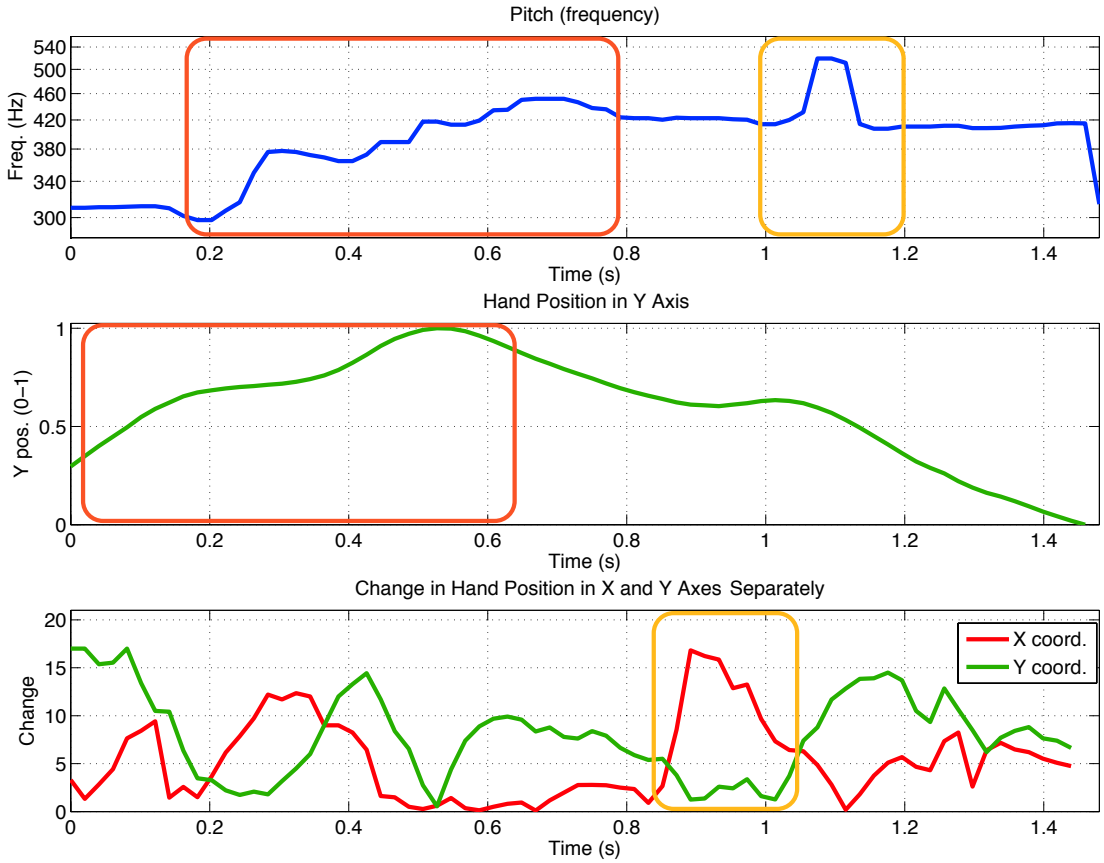

Figure 6.4: SV demonstration phrase 36 (Media File 6.4). This figure shows pitch movement (blue line) plotted above hand position in the y-axis (green line) above the derivative of position in two axes viewed separately. The boxes highlight the connections between pitch movement and hand movement, first in the y-axis (red box) and then in the x-axis (yellow box).

In this phrase the overall y-axis correlation coefficient (with high pitch as high hand position) is only r = 0.14, while x-axis correlation is r = 0.55. Although individually these are only low to moderate correlations, the combined hand motion in both axes, still map the significant pitch movements of the phrase.

In summary, the correlation coefficient found between pitch and hand position in many phrases tends to be lowered by qualities inherent in the material. These qualities include the return of the hand to the knee before the phrase has been completed, the varied offsets found between hand movement and corresponding pitch movement, and the tendency to map different parts of the same phrase in different axes. Therefore, considering the tendency of such factors to lower global correlation, I would suggest that the correlations found should be considered noteworthy, notwithstanding their low to medium strength.

In the following section of this chapter, the data collected are examined using qualitative techniques in order to provide further insight into the connection between hand position and pitch in Karnatak vocal lessons

6.6 Qualitative exploration of mapping

The aims of this section are first to examine the gesturing characteristics of each teacher, second to consider the role played by gesture in phrase segmentation, and third to explore the way in which mapping between pitch and hand position can contribute to the prevention and correction of student error. Both aims will be achieved through qualitative techniques including visual comparison of sound and movement data in individual phrases, and description of the immediate pedagogic context from observation of the video recordings. Through this analysis I aim to provide more insight into the significance and characteristics of mapping between pitch and hand position in this context than that afforded by quantitative analysis alone.

6.6.1 Characteristics of mapping in the gestures of each teacher

1) Suguna Varadachari

As discussed above (see section 6.5.5), the gestures produced by SV showed the strongest correlation between pitch and hand position of the three teachers. This is particularly noteworthy considering that the phrases sung by SV were longer on average than those of the other two teachers, as when analysing such data, strong correlations tend to be harder to find in long phrases (Smith and Strader 2014, p. 7).

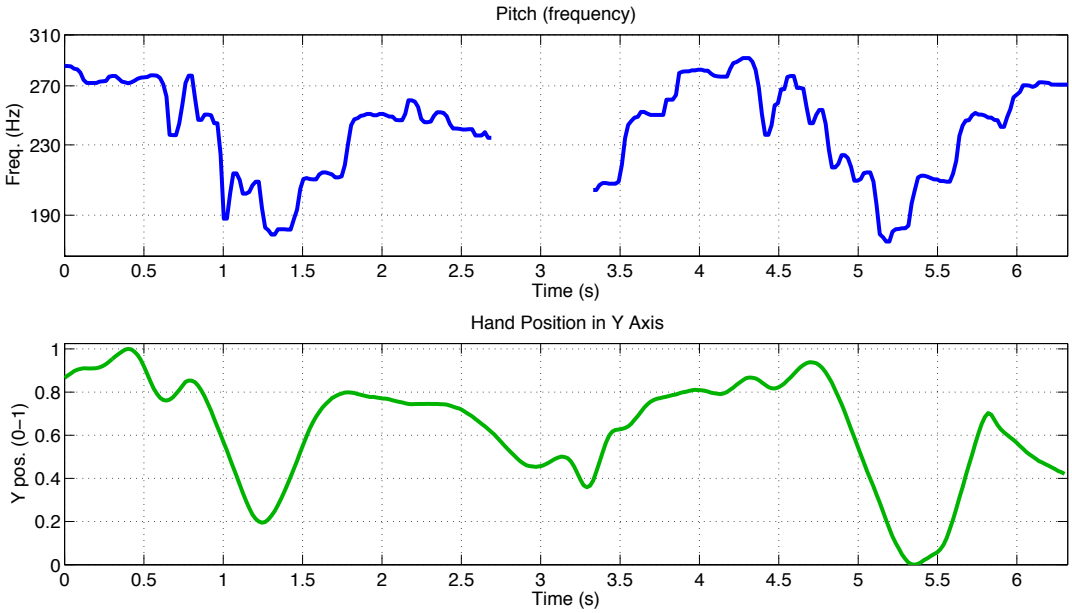

Figure 6.5: SV correction phrase 7 (Media File 6.5). This figure shows pitch movement (blue line) plotted above hand position in the y-axis (green line). The gap in the blue line denotes a break in the vocal line. Here the broad melodic shape of the phrase can be seen in the hand movements, but finer details are not mapped. Correlation between pitch and hand position in the y-axis here is r = 0.75.

Looking more closely at phrases sung by SV in which there is a strong correlation between pitch and hand position, the broad melodic shape of the phrase is typically mapped by hand movement in the y-axis, while many of the fine-grained inflections are absent. When the position points are plotted, the visual result is that hand position in the y-axis looks rather like a smoothed version of the pitch plot (see Figure 6.5, showing Media File 6.5).

A similar effect can be seen in another example from the lesson given by SV (see Figure 6.6, Media File 6.6). Here, once again hand motion in the y-axis mirrors the general melodic shape of the phrase, but the fine-grained pitch inflections appear as though ironed out; for example, the small leaps in pitch just before and after the five-second point cannot be seen in the y-axis position contour. However, looking at the lowest plot showing change in hand position (the first derivative of absolute position in the x and y-axes combined) it is apparent that the pitch details at around the 5-second point of the phrase have been mapped by rapid movements in the x-axis (see yellow boxes in Figure 6.6).

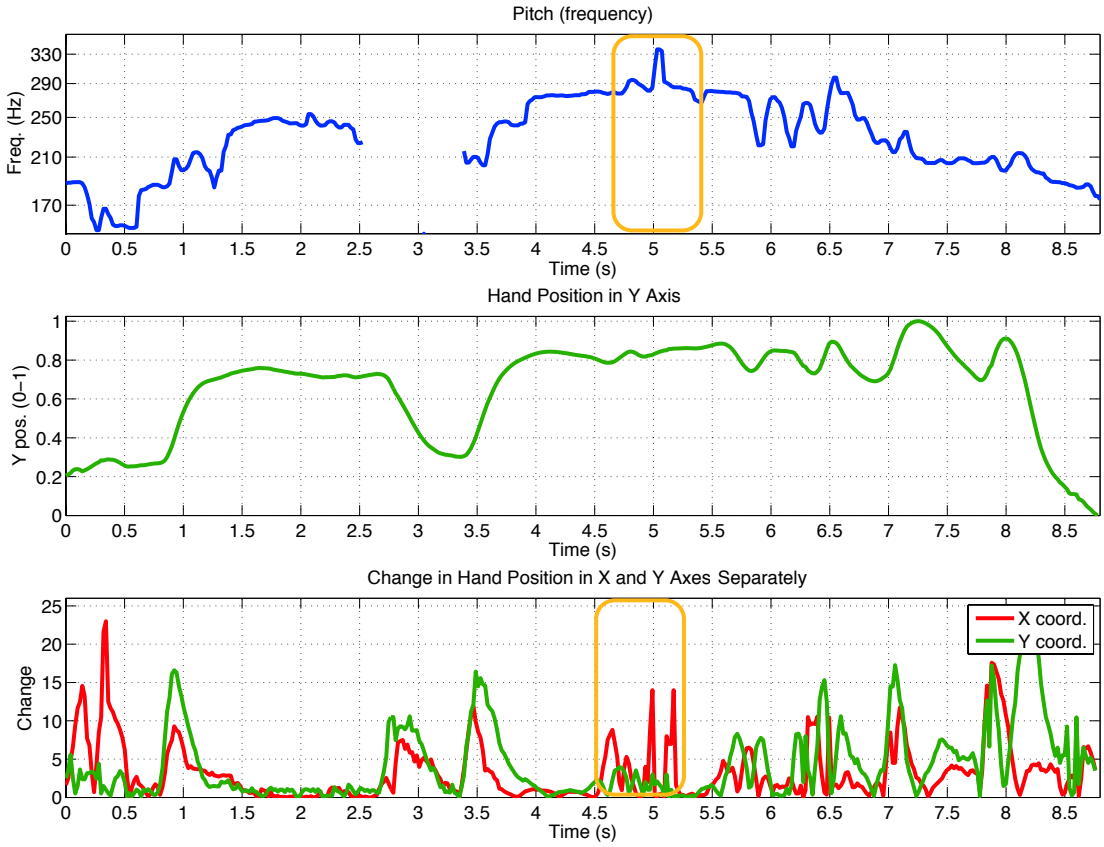

Figure 6.6: SV demonstration phrase 2 (Media File 6.6). This figure shows pitch movement (blue line) plotted above hand position in the y-axis (green line), and change in hand position in x and y-axes (overlaid red and green lines in the lowest plot). The gap in the blue line denotes a break (silence) in the vocal line. The broad shape of the phrase can be seen mapped on to hand position in the y-axis position (middle plot), while some of the brief leaps in pitch are mapped on to change in position in the x-axis in the lowest plot. The two yellow boxes highlight hand movements and the pitch changes to which they correspond. Correlation between pitch and hand position in the y-axis here is r = 0.72.

2) T.V. Ramanujacharlu

The gestures produced by TKV contrast strongly with those of SV, showing little consistent mapping between pitch height and hand height. Instead, TKV's phrases often show mapping in different axes at different points of the same phrase, which accounts, in part, for the low overall correlations in individual axes for entire phrases. Figure 6.7 (Media File 6.7) shows a typical relationship between pitch and hand position in a correction phrase sung by TKV. Here the shape of the melody can be easily seen in the hand movement, both in the x and y-axes. However, correlation is low, as hand movements do not consistently map the pitch movement in one axis across the entire phrase.

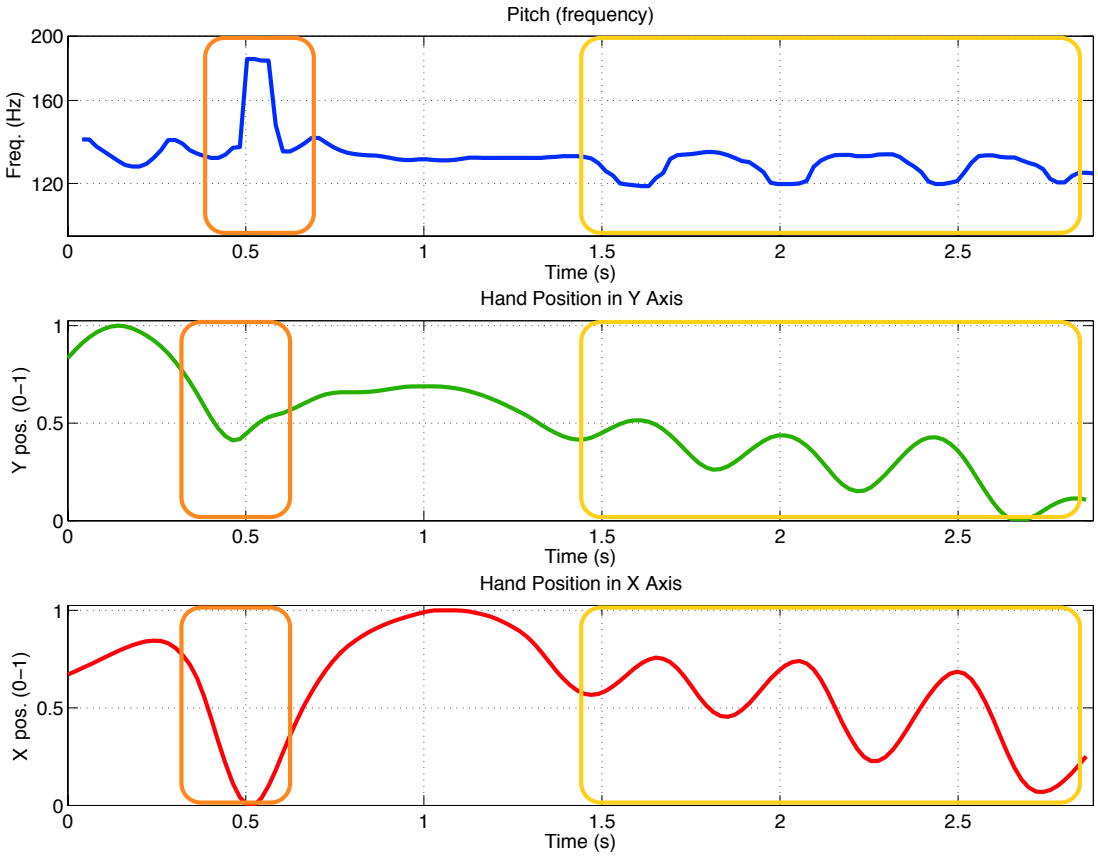

Figure 6.7: TKV correction phrase 4 (Media File 6.7). This figure shows pitch movement (blue line) plotted above hand position in the y-axis (green line), and hand position in the x-axis (red line). The pitch movements can be seen in the hand movements, but the correlation is low. The orange boxes highlight the leap up in pitch and corresponding hand movements, and the yellow boxes highlight the oscillations at the end of the phrase.

In Figure 6.7, it can be seen that the upward leap in pitch near the beginning of the phrase is mirrored by a sharp hand motion seen in both the y and x-axes. In the y-axis this upward pitch leap is mapped with a downward hand movement, working against the high pitch to high spatial position cross-domain mapping commonly found in experiment-based studies (Eitan and Granot 2006; Küssner 2014). The second part of the phrase consists of slow oscillation in

pitch. Although this is mapped by an oscillation in the hand movement, this does not form a one-to-one mapping with either the x or y-axes as the hand movements are offset from the pitch movements. Due to these factors, correlations between pitch and hand position for the phrase as a whole are low: only r = 0.22 in the y-axis and r = 0.14 in the x-axis.

In many cases, the mapping that does exist between melodic and physical movement in TKV's phrases can be seen more clearly by plotting the derivatives of pitch and hand position. In Figure 6.8, the same phrase as shown in Figure 6.7 is visualised together with the derivatives of pitch and hand position (change in pitch and change in hand position). Here, the correspondence between change in pitch and change in hand position is evident, illustrating the way in which TKV's gestures often map pitch change on to change in hand position, rather than position in a particular axis.

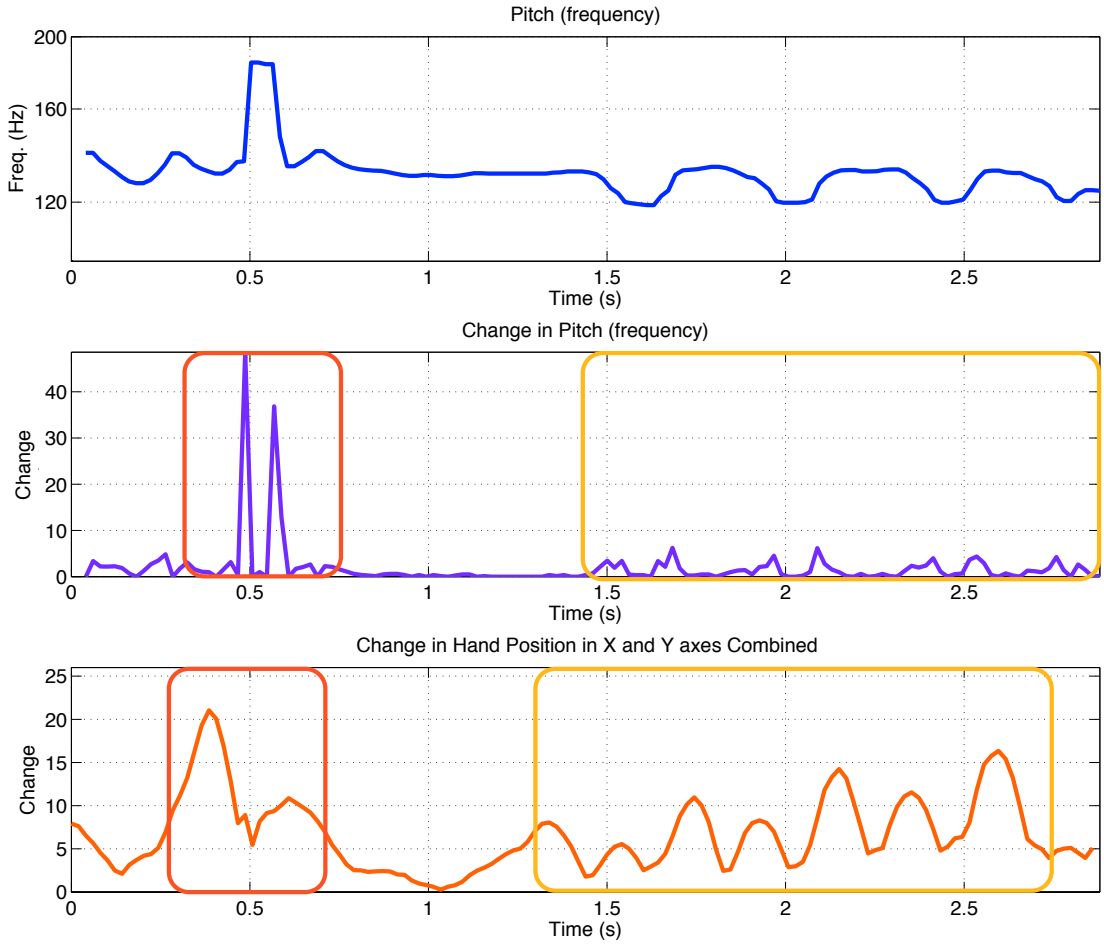

Figure 6.8: TKV correction phrase 4 (Media File 6.8). This figure shows pitch movement (blue line) plotted above change in pitch (purple line) and change in hand position in x and y-axes combined (orange line). The correspondence between the lower two plots is evident, even though the extent of the movements differ.

3) T.S. Sathyavathi

As shown by the results of the quantitative analysis in this chapter (section 6.5.5), the gestures produced by TS display a closer mapping between pitch height and hand height than those of TKV, whilst not being as strongly correlated in these domains as the gestures made by SV. Looking closer at TS's gestures, they often appear to present a schematic representation of *gamaka* and *svara*, rather than a precise mapping of pitch. An example of this tendency can be seen in Figure 6.9 (Media File 6.9), where an oscillating *gamaka* is accompanied by an oscillating hand motion. However, it is clear from the plot that the two do not match in timing or in number: the hand movement oscillations are more numerous than those seen in the melodic motion. In this case, the hand movement seems to represent the quality 'oscillation', rather than mapping the actual pitch movement.

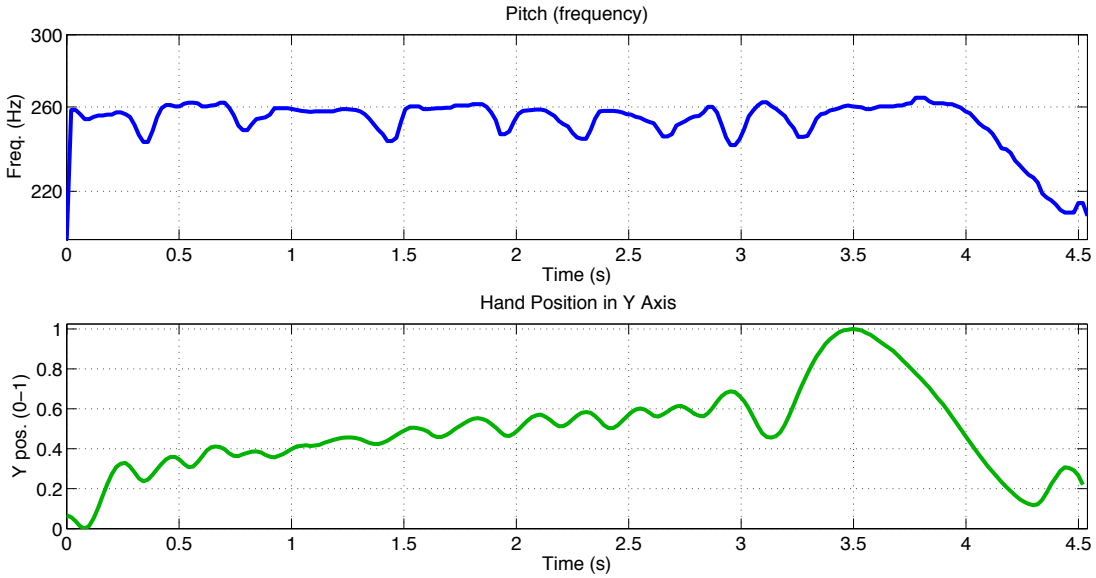

Figure 6.9: TS demonstration phrase 6 (Media File 6.9). This figure shows pitch movement (blue line) plotted above hand position in the y-axis (green line). Here, although both hand and pitch are oscillating, the two do not match precisely, with more oscillations in the hand motion than in the pitch movement.

Often TS's hand motions correspond to changes in *svara*, without mapping the *gamakas* that join them, as can be seen in the example in Figure 6.10 (Media File 6.10). Here, TS sings a correction phrase accompanied by three distinct changes in hand position to highlight each of the three *svaras* in the phrase: *dha-sa-ri*. Three of the highest peaks in change in hand position (the first derivative of hand position in the x and y-axes combined) correspond to the start of the three *svaras* in the phrase, preceding pitch change by up to 200ms. Here correlation between pitch and hand position in the y-axis is fairly weak ($r = 0.36$), but the *svara* changes can still be seen clearly in the peak changes in hand position.

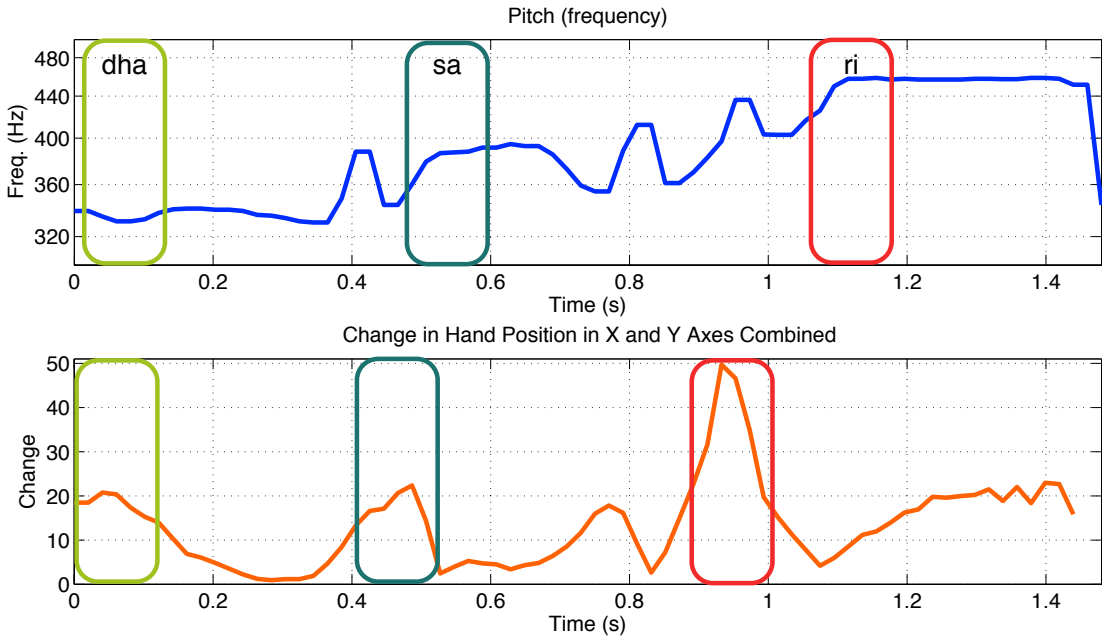

Figure 6.10: TS correction phrase 22 (Media File 6.10). This figure shows pitch movement (blue line) plotted above change in hand position in x and y-axes combined (orange line). Three of the highest peaks in change in hand position correspond to the beginning of the three main *svaras* in the phrase, preceding them slightly.

In order to better understand why there is such a wide range of correlations between pitch and hand position in individual phrases, it would seem worth exploring what is being indexed by gesture when correlation in both axes is low. For example, Figure 6.11 (Media File 6.11) shows a phrase from the lesson given by TS in which mapping between pitch and position is low in both the x and y-axes: r = 0.14, and r = - 0.14 respectively. The phrase consists of a rapid series of *svaras* (*ri-ga-ma-ri-ga-ri-sa*) linked through oscillations. Looking at the hand position data, there is very little motion in either axis until the final pitch is touched at which point there is a sudden upward hand movement. This is a gesture often used by TS in her lessons to indicate that the final pitch should be released quickly rather than sustained. So in this example, it is the duration and emphasis of the final *svara* that is being indexed by gesture, and pitch position is not mapped at all.

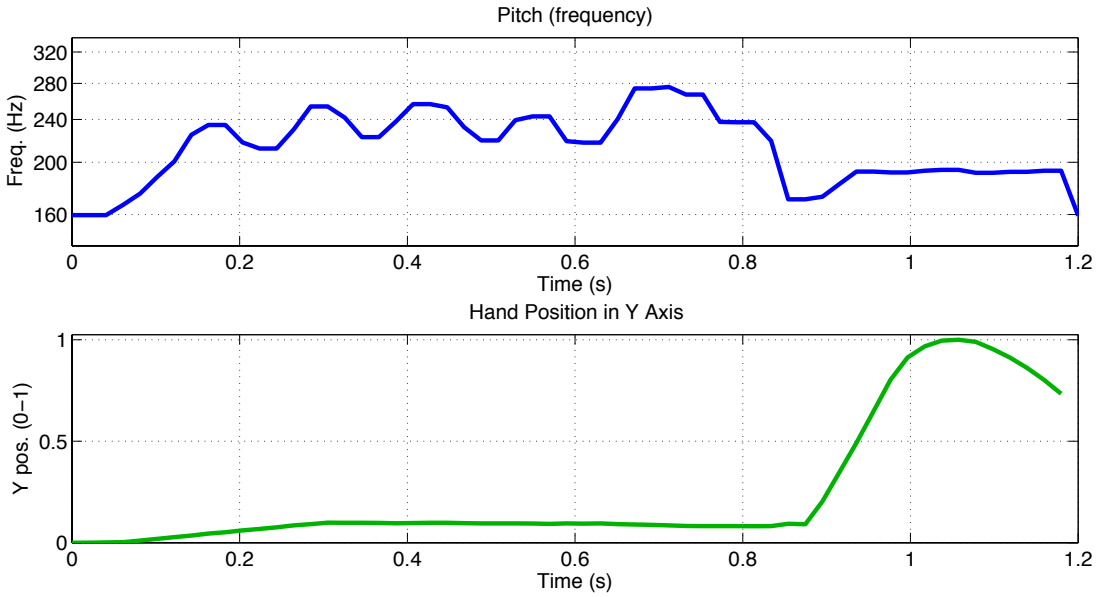

Figure 6.11: TS demonstration phrase 107 (Media File 6.11). This figure shows pitch movement (blue line) plotted above hand position in the y-axis (green line). Only the final 'release' motion is seen in the y-axis, in which there is a sudden upward movement occurring as the final *svara* in the phrase in sung.

6.6.2 Segmentation

Another example of musical features other than pitch being mapped can be seen in a demonstration phrase sung by TKV (see Figure 6.12, Media File 6.12). Here, mapping between pitch and hand position is low in both axes (y-axis r = - 0.07, x-axis r = 0.23). Instead, the gestures appear to chunk the phrase into sections. The hand movements here begin with two circles, highlighted by green boxes in Figure 6.12, that segment the phrase into two melodic motifs, each ending on a stable tone: *pañcama* and *ṣaḍja*. The two *svaras* that close the phrase, *dhaivata* and *pañcama*, each coincide with a sweep of the hand across the x-axis (the first short and the second long), highlighted by the orange boxes in Figure 6.12. In this way, the teacher's hand movements segment this three-second phrase into four shorter chunks that correspond to meaningful melodic units in the phrase: two motifs comprising multiple *svara-gamaka* units, oscillating on their ascent up to the stable pitches *pañcama* and *ṣaḍja* (*ma-pa*; *dha-ni-sa*), and two individual *svara-gamaka* units (*dhaivata* and *pañcama*) at the end of the phrase. In this way, the teacher can be seen to index borders between gestural-sonic chunks, rather than pitch.

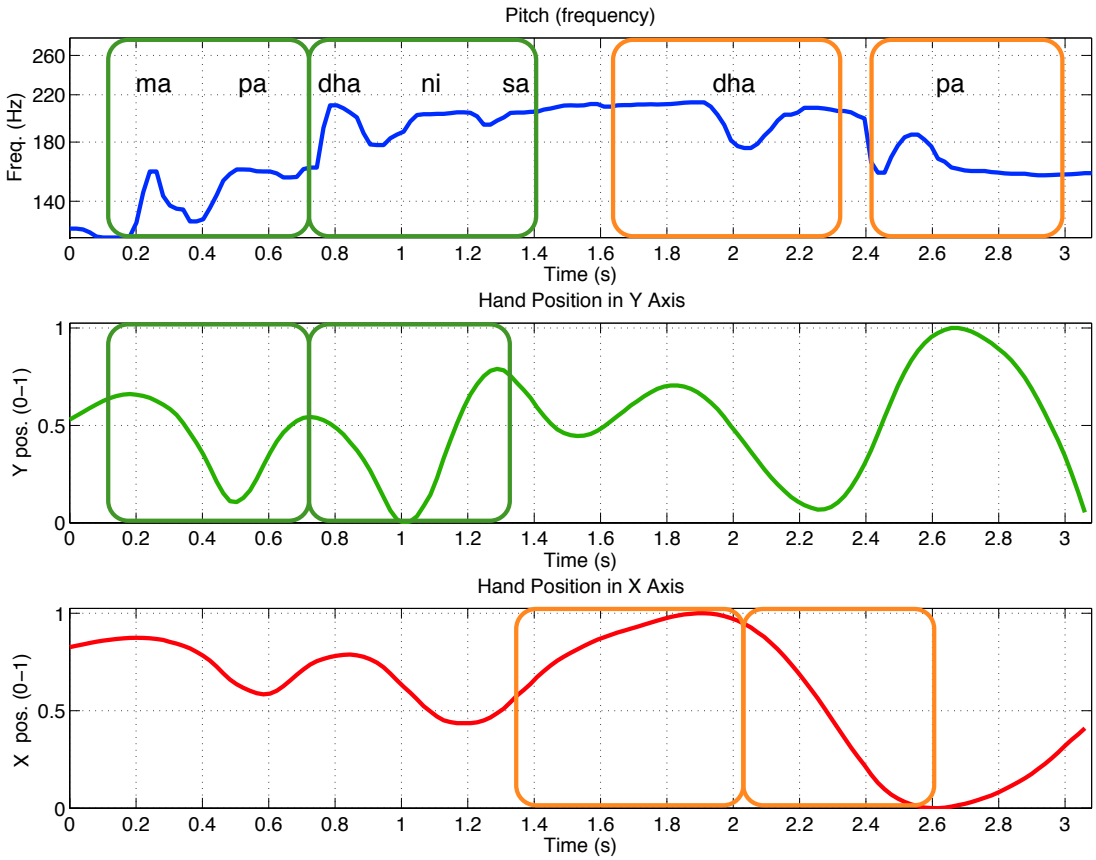

Figure 6.12: TKV demonstration phrase 43 (Media File 6.12). This figure shows pitch movement (blue line) plotted above hand position in the y-axis (green line) and hand position in the x-axis (red line). The two green boxes highlight two circular gestures that segment the first two motifs of the phrase, while the two orange boxes highlight two sweeps of the hand (the first short and the second long) across the x-axis that act to segment the last two *svaras*.

Segmentation produced by head movements during speech has been proposed to aid intelligibility for the listener in a manner similar to the segmenting effects of auditory prosodic structure (Munhall et al. 2004, pp. 133 and 136).[39] In the present context of a vocal lesson, it is possible that gestural segmentation may similarly help students comprehend their teacher's phrases. This would be particularly useful in Karnatak music where the borders of conceptually discrete *svaras* tend to become blurred through the coarticulatory qualities of the style (see chapter 3). Segmentation through hand gestures may help students locate the borders between *svara-gamaka* units, as well as motifs formed from chains of such units. The gestures could aid student comprehension by segmenting phrases into meaningful gestural-sonic chunks, thereby informing the student of the teacher's conception of the phrase. Segmenting gestures could equally provide the musicologist with insight into the vocalist's

[39] See also Cutler et al. (1997) for a review of segmentation and prosody in the comprehension of speech.

conception of the phrase being sung, indicating the borders between meaningful motifs within a longer phrase.

In the discussions above, I have shown that gestures often index aspects of music other than pitch, including features such as phrase segmentation, points of emphasis, and qualities of release. Such findings raise the possibility that teachers' gestures may tend to index the aspect of the music on which they are focused. Although it is difficult to discern the focus of the teacher, some insight might be gained through examination of trouble spots in lessons, as at these moments we might reasonably assume that the teacher will focus on conveying the solution to the error made by the student. Therefore, in the next section I explore the role played by gestures together with other pedagogic techniques in error correction.

6.6.3 Error repair and mapping between pitch and hand position

The primary tool used by Karnatak vocal teachers when a student fails to imitate a phrase correctly is simple repetition of the phrase. This may be accompanied by either the same hand gestures produced during the initial demonstration, or with slightly altered gestures that draw attention to the solution to the student's error. In addition, teachers may alter their vocal rendition slightly to emphasise the solution to the error. Another effective pedagogic technique commonly used to repair student error is for the teacher to repeat the phrase singing the *svara* names (the *sargam* syllables) rather than the meaningless syllables used for *rāga ālāpana* performance. As described in section 3.8.1 of this thesis, knowing which *svara* is being sung can often help students correctly reproduce the *gamaka* with which it is performed, probably through previous associations between the *svara* name and the *svara-gamaka* unit used to realise it in that *rāga*. The pedagogic technique of error repair through repetition with *sargam* names is most often used when the student has fundamentally misunderstood some of the *svaras* and associated *gamakas* sung by the teacher. Finally, verbal correction that indicates the solution to the student's error using either a single word or an entire sentence may be used, although this tends to be employed as a last resort after the student has made the same mistake on several occasions. In Karnatak music lessons, especially when teaching *rāga ālāpana*, it is considered important to maintain musical flow. Verbal corrections interrupt this flow and so are used less frequently than the other methods discussed here.

The various pedagogic techniques described above are skilfully employed by teachers to help their students understand the solutions to their musical errors. Two lesson interactions will be examined in detail in order to illustrate the role sometimes played by mapping between pitch and hand position in helping to repair student error.

Example 1: Indexing *gamakas*

The following interaction is taken from the lesson given by TKV, in which he is teaching *ālāpana* in *rāga* Śaṅkarābharaṇam. In this example, the student fails to understand a phrase demonstrated by TKV, leading him to repeat the phrase in an attempt to repair the student's error. TKV's gestures in the initial demonstration phrase show only weak mapping between pitch and hand position in both axes (y-axis: r = 0.21, x-axis: r = 0.25). Instead his gestures segment the phrase using four sweeping lateral motions that coordinate with the four main phrase motifs (see Figure 6.13). The only pitch movement mapped to the y-axis here is the downward motif, *pa-ma-ga*, at 1.6 seconds into the phrase.

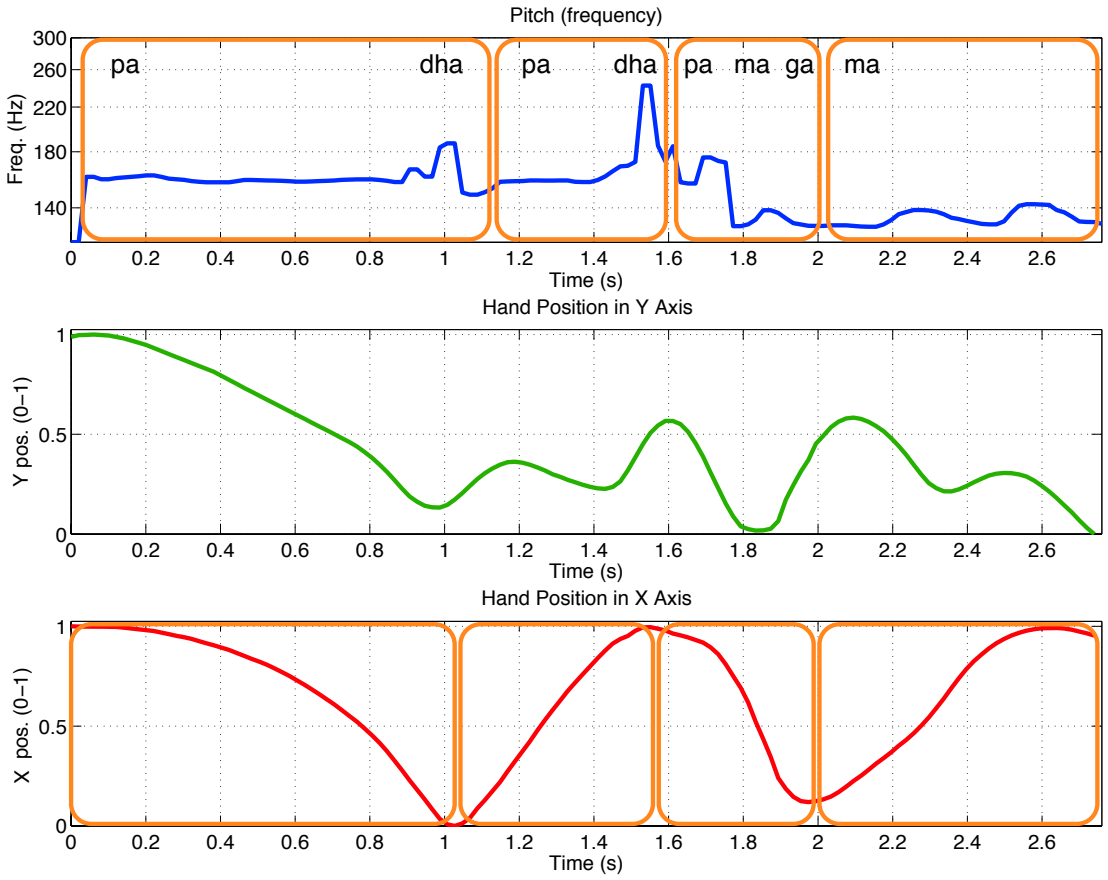

Figure 6.13: TKV demonstration phrase 27 (Media File 6.13). This figure shows pitch movement (blue line) plotted above hand position in the y-axis (green line), and hand position in the x-axis (red line). Mapping between pitch and hand position is low in both axes: y-axis r = 0.21, x-axis r = 0.25. The orange boxes in the x-axis plot highlight the segmentation of the phrase into four motifs using sweeping lateral gestures.

Following this initial demonstration, the student attempts the phrase but fails to imitate it correctly, showing fundamental misunderstanding of the *svaras* and *gamakas* within it. TKV repeats the phrase, sung this time with the *svara* names (*sargam*), and using gestures that differ from those in the initial demonstration (see Figure 6.14). In this first correction phrase,

the sweeping lateral hand movement is absent. Instead, the initial upward leap to *dhaivata* is highlighted by a small downward movement, and the vocal oscillation at the end of the phrase is mapped by two circular hand motions.

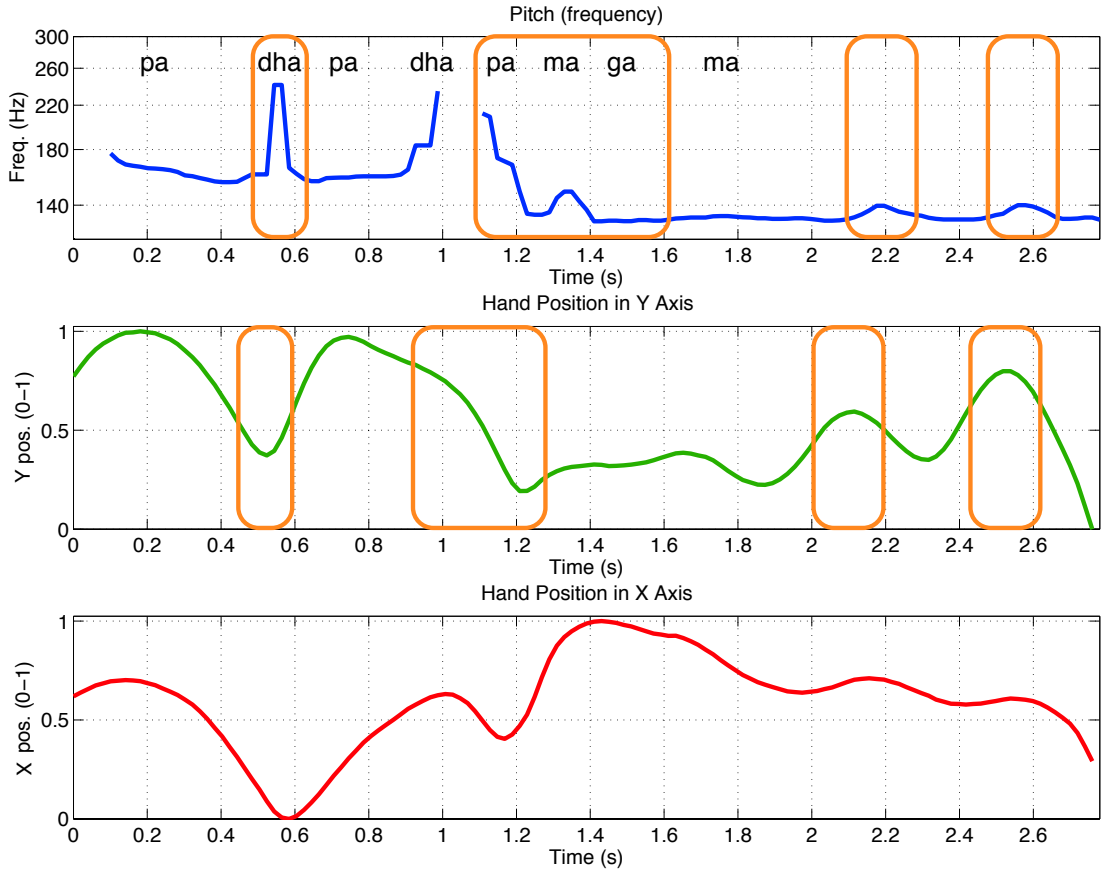

Figure 6.14: TKV correction phrase 22 (Media File 6.14). This figure shows pitch movement (blue line) plotted above hand position in the y-axis (green line) and hand position in the x-axis (red line). Mapping between pitch and hand position is moderate: y-axis r = 0.55, x-axis r = - 0.50. The orange boxes highlight the relationship between hand movement and pitch movement, with hand movement often preceding pitch movement.

The student makes a second attempt to imitate, but fails to complete the phrase and so TKV repeats once more with *sargam*. In this second correction, there is an even tighter correspondence between gestures and pitch movements (y-axis r = 0.62, x-axis r = - 0.62) (Figure 6.15, Media File 6.15). On this occasion, both upward leaps in pitch to *dhaivata* are indexed by downward hand movements (see Figure 6.15). In addition, the four segments of the phrase can still be seen in the x-axis hand motion, as highlighted by the green boxes in the lowest plot of Figure 6.15.

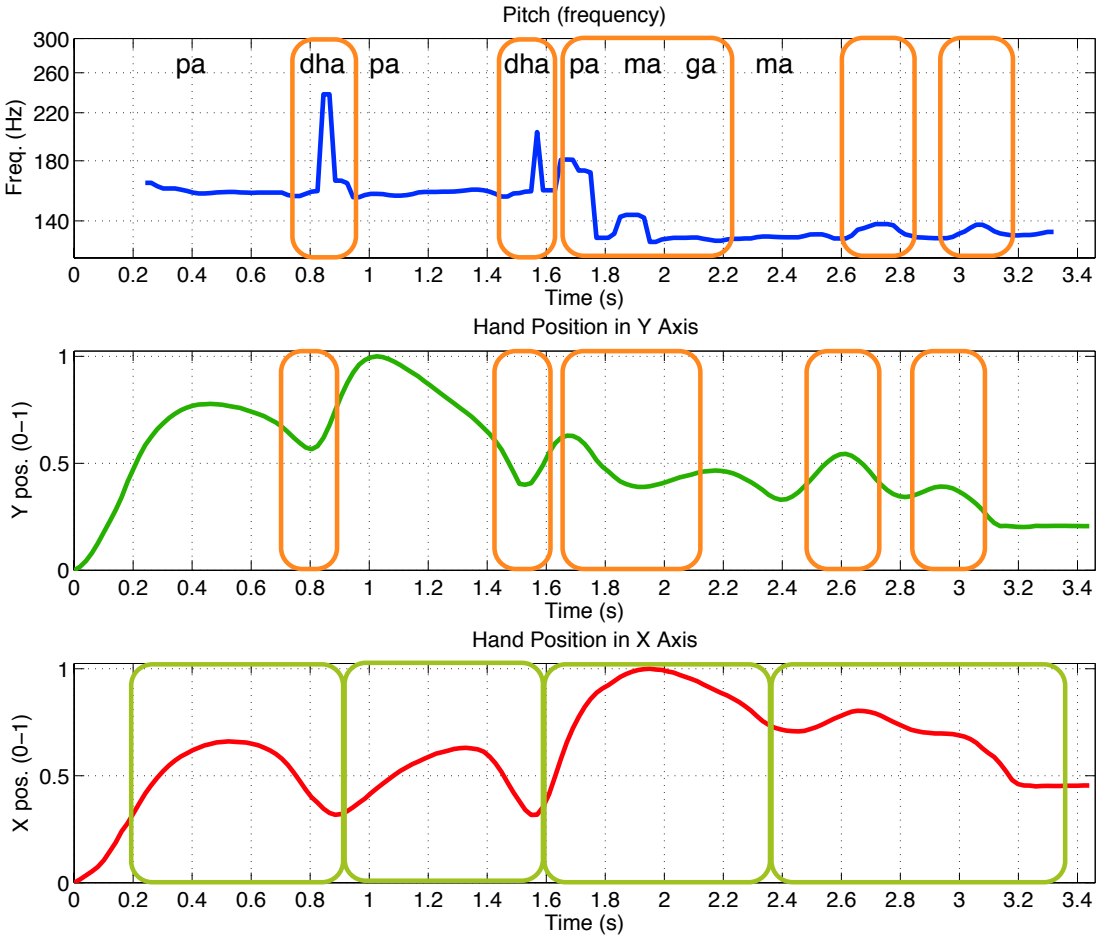

Figure 6.15: TKV correction phrase 23 (Media File 6.15). This figure shows pitch movement (blue line) plotted above hand position in the y-axis (green line), and hand position in the x-axis (red line). Mapping between pitch and hand position is strong: y-axis r = 0.62, x-axis r = - 0.62. The orange boxes here highlight the relationship between hand movement and pitch movement, and the green boxes indicate the chunking of the phrase into four segments in the x-axis motion.

To summarise, in this interaction, the gestures in the teacher's initial demonstration phrase show low mapping between pitch and hand movement, and instead function to segment the phrase into four motifs. However, after the student fails to understand the *svaras* and *gamakas* in the phrase, the gestures in the teacher's subsequent correction phrases map the pitch movement of the *svara-gamaka* units in the y-axis. As a result, overall correlation between pitch and hand position in the phrase rises with each repetition. In this example, the increase in mapping between pitch and hand position indexes pitch movement in a way that may benefit the student, helping them to perceive the melodic leaps and oscillations required.

Example 2: Scaffolding

In addition to providing information on pitch movement, correspondence between pitch and hand movement in gestures can act as scaffolding on which information regarding other

musical qualities may be hung. An example of this can be seen in another interaction from the lesson given by TKV.

In the initial demonstration phrase, TKV sings a rising and falling figure while producing gestures that trace undulating circles. Here, there is little mapping between pitch and hand position until the final downward pitch movement of the phrase, which is accompanied by a downward and sideways hand movement (see the red box in Figure 6.16, and Media File 6.16).

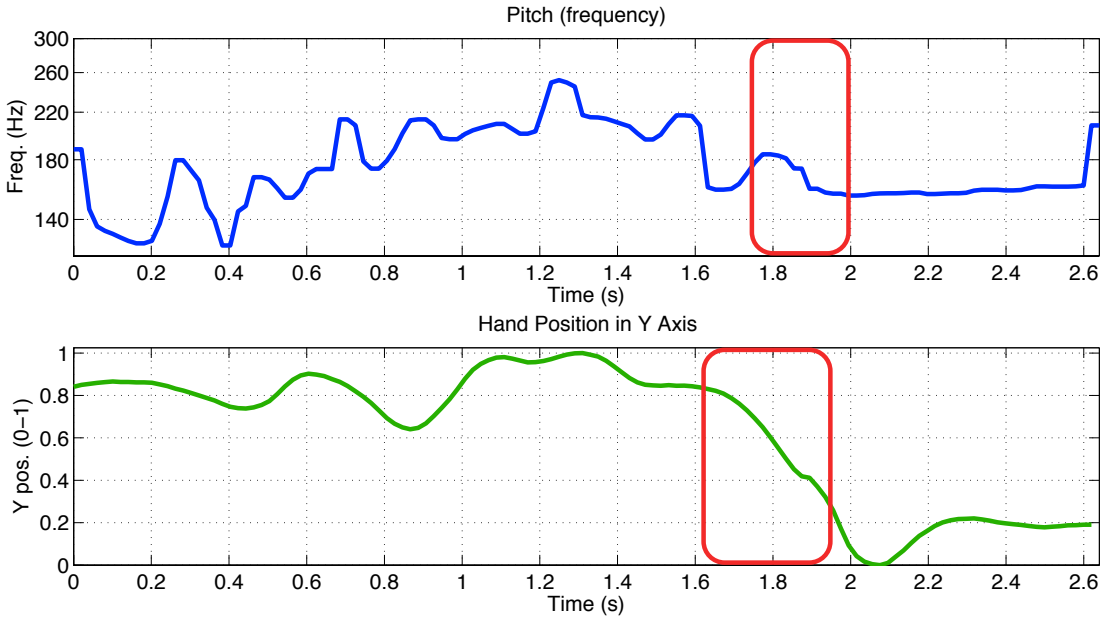

Figure 6.16: TKV demonstration phrase 45 (Media File 6.16). This figure shows pitch movement (blue line) plotted above hand position in the y-axis (green line). Overall mapping between pitch and hand position is moderate to weak: y-axis r = 0.46, x-axis r = 0.16. The red boxes highlight the only observable correspondence between pitch and hand position in the y-axis, with a downward hand movement occurring with a downward pitch movement onto *pañcama* (see Media File 6.16).

The student imitates the phrase fairly accurately, but makes an error in the number of syllables articulated, singing three where there should only be two. The teacher, therefore, repeats the phrase, but this time with quite different gestures. In the correction, pitch is clearly mapped on to hand position in the y-axis with the hand moving up as the pitch moves up and down as the pitch moves down (see Figure 6.17, Media File 6.17). The hand movement for the phrase as a whole is cut into two, changing direction at the point where the new syllable is required. I would suggest that in this case, the mapping of pitch on to the vertical axis acts as a scaffold for conveying the solution to the student's error, providing a clear map of the phrase in space that supports the pertinent information: where to place the articulation. Here, mapping between pitch and hand position could assist in the comprehension of other musical information, by making it clear where the new syllable begins.

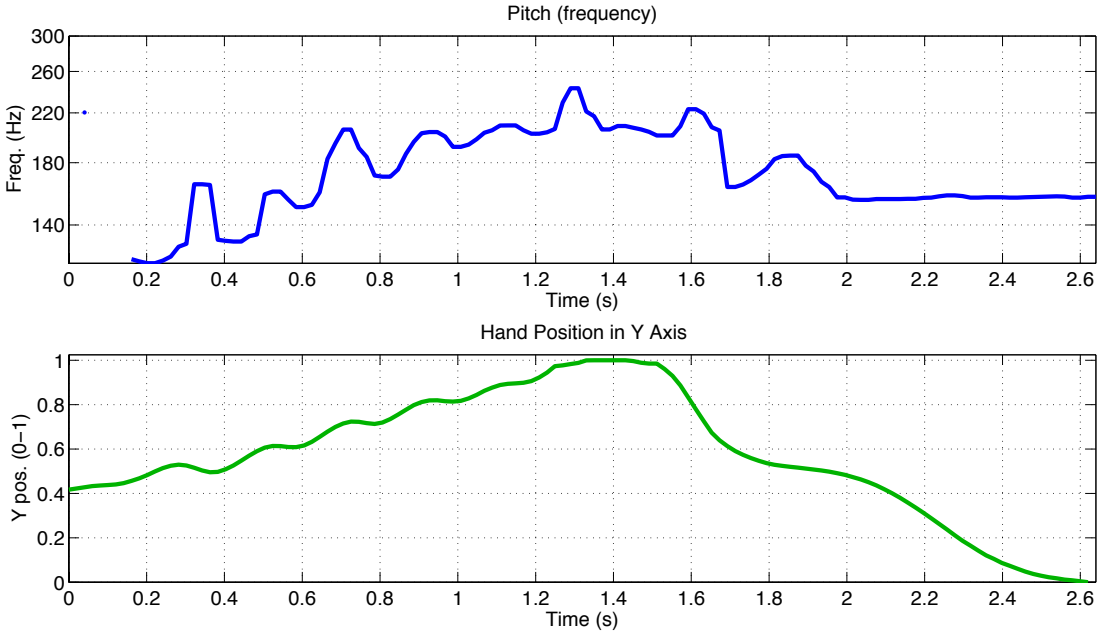

Figure 6.17: TKV correction phrase 43 (Media File 6.17). This figure shows pitch movement (blue line) plotted above hand position in the y-axis (green line). Mapping between pitch and hand position is higher here than in the original demonstration: y-axis r = 0.74, x-axis r = - 0.54.

Following the teacher's first correction, the student repeats the phrase correctly, but perhaps a little indistinctly. In order to be sure she has understood, the teacher sings the phrase again, this time with an even stronger mapping between pitch and hand position: y-axis r = 0.80, x-axis r = - 0.76 (see Figure 6.18, Media File 6.18). In addition to matching the general melodic curve, some of the oscillations that form the ascending phrase are now matched by corresponding steps in the upward hand movement (see dotted lines in Figure 6.18).

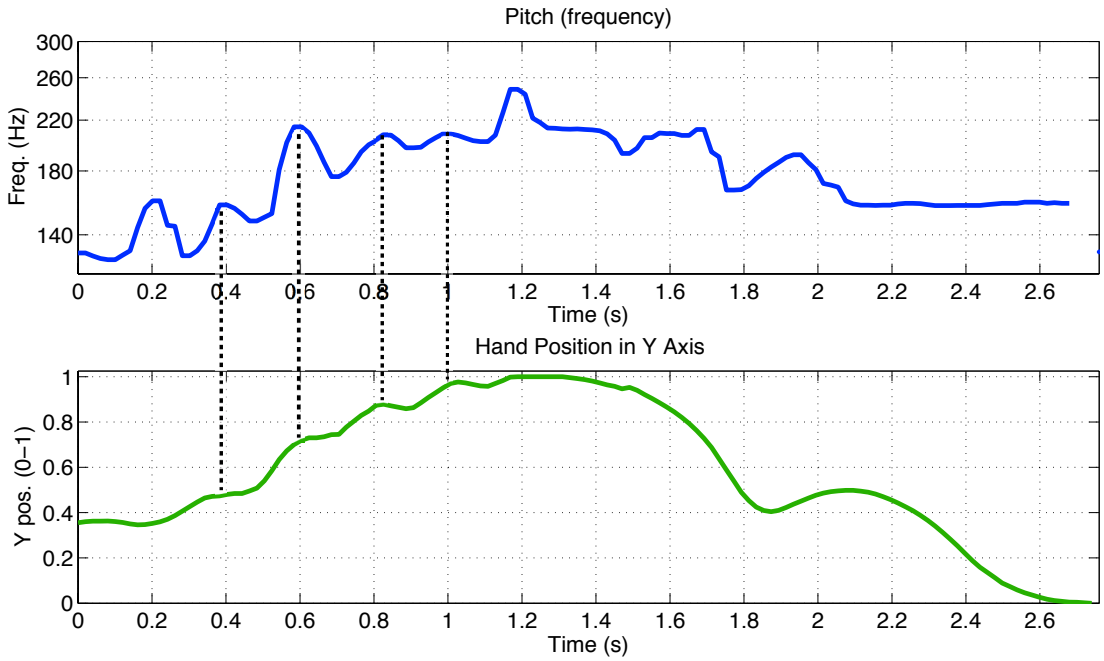

Figure 6.18: TKV correction phrase 44 (Media File 6.18). This figure shows pitch movement (blue line) plotted above hand position in the y-axis (green line). Mapping between pitch and hand position is stronger in this final correction phrase (y-axis r = 0.80, x-axis r = - 0.76) compared to the two previous demonstrations. The dotted lines highlight points of correspondence between pitch and hand movement.

While the two pedagogic interactions discussed in this section provide examples of gestures altering between demonstration and correction phrases to more closely map the solution to student error, it should be noted that such change does not always take place. Teachers often sing correction phrases with a gesture that is similar to that used in the original demonstration. Nevertheless, examples such as those presented here illustrate the way in which gestures have the potential to contribute to the correction of student error, and demonstrate that mapping between pitch and hand position can play an important role in such cases.

6.7 Conclusions

In summary, the findings here show that across all phrases analysed there was a weak to moderate positive correlation between hand position and pitch, with the extent of correspondence varying between teachers. Globally, correction phrases did not show a stronger correlation between pitch and hand position than demonstration phrases. There was wide variation in the extent of mapping in individual phrases, with some showing a very strong correlation between pitch and position, while others showed only a very weak correlation between the two variables. Difficulties presented by the material for quantitative analysis were discussed.

Using a qualitative approach, examination of hand motion and melodic movement in individual phrases showed that in addition to pitch, other musical features were often indexed by gesture, including the boundaries of smaller melodic units within the wider phrases. The melodic units segmented consisted of motifs comprising either single *svara-gamaka* units, or strings of such units forming longer motifs. Individual *svaras* within these motifs were typically coarticulated, often through the oscillations that are characteristic of the style. Similar chunking functions have been ascribed to both head gesture (Munhall et al. 2004), and acoustic prosody (Cutler et al. 1997), both of which have been linked to improved speech comprehension. In Karnatak vocal lessons, segmentation cues provided by co-singing gestures may similarly improve melodic comprehension by highlighting the borders between meaningful musical units. In my experience of learning to play Karnatak violin, long streams of coarticulated melody are difficult to imitate, while smaller chunks are far easier to grasp. Another possible benefit of segmenting longer phrases into smaller chunks is that while the overall phrase may be novel to the student, the smaller chunks of which it is comprised may be remembered from another context. In such ways, I suggest that the segmentation of phrases through gesture has the potential to improve students' ability to comprehend and imitate their teachers' demonstrations.

Finally, this chapter discussed the way in which mapping between pitch and hand position in teachers' gestures might contribute to repair of student errors. Two pedagogic interactions were examined in detail, in which the degree of mapping between pitch and hand position in a teacher's gestures increased as he attempted to convey the solution to the student's error. However, it was noted that teachers' gestures do not always alter in response to students' errors, and that gesture is only one amongst several pedagogic tools that may be used to correct such errors.

While this chapter has shown that there is a global positive correlation between pitch and hand position in teachers' gestures, and that in certain phrases correspondence between pitch and hand position can be used to index the solution to a student's error, it does not necessarily follow that the gestures help students learn. Instead, it is possible that the gestures simply reflect the teacher's focus at any given moment and are of no benefit to the student. However, the testimony of teachers and students presented in chapter 5 of this thesis contradicts such an interpretation, with the majority of teachers and students clearly stating that gestures help students understand various aspects of the music. Furthermore, there have been experiment-based studies on gesture in non-musical contexts that provide support for the proposal that gestures can positively affect student learning by grounding concepts (in this case musical concepts) in physical action (see Valenzeno et al. 2003; Cook et al. 2013). Such evidence will be discussed further later in this thesis (chapters 8 and 9), where the question of

how teachers' gestures contribute to the Karnatak music learning process is considered in greater depth.

Karnatak music is replete with subtle *gamakas* containing fleeting *anusvaras* that are not notated, but that must be reproduced precisely. Furthermore, the style includes long coarticulated phrases that can be difficult for students to comprehend. I propose that the mapping between pitch and hand position found in the analyses here suggests that teachers' gestures have the potential to play a role in helping students grasp elements of the complex melodic motion that they might otherwise struggle to perceive through sound alone.

7 Metaphor, Iconicity, and Mapping in Co-singing Gestures

7.1 Introduction

While the previous chapter presented an examination of mapping between gesture and pitch, here I will explore mappings between gesture and other musical qualities such as emphasis, loudness, attack, release, and timbre. In particular, I aim to elucidate how such qualities are indexed through the gestures observed in Karnatak vocal lessons. In this way, my objective is to contribute further to the research questions posed at the beginning of this thesis, regarding what musical features are indexed through gesture, and how such indexing contributes to the learning process.

The chapter opens with a discussion of the connection between conceptual metaphor and cross-domain mapping before considering the various ways in which gestures can be regarded as either metaphoric or iconic. This is followed by a critical review of approaches taken to metaphor and iconicity in some of the existing literature on music and gesture. The first part of the chapter closes with a presentation of the musical and gestural qualities that will be explored in the analysis section that follows. The second part of the chapter comprises analyses of pedagogic interactions within lessons given by three Karnatak vocal teachers, looking at the ways in which their gestures index musical qualities other than pitch. The results of these analyses are summarised in a table listing gestural qualities, corresponding musical qualities, and the experiential and physical basis of the mapping between the two (Table 7.4). Finally, the role played by teachers' gestures in conveying the required qualities of musical motion to their students is considered.

7.2 Conceptual metaphor and cross-domain mapping

During interviews conducted in the course of this research, I asked Karnatak vocal teachers what, if anything, their gestures indicated about the music being sung. Aside from their comments on *svara* and *gamaka* (see sections 5.3.2 and 5.3.3), teachers also noted that their gestures could indicate 'pressure', 'stress', 'weight' and 'pulsation', all terms that are commonly used to refer to qualities of motion and the effects of physical forces on objects. The common use of movement and force metaphors in music-related speech has already been discussed in this thesis (see section 1.5). Here, I will elaborate on the topic of conceptual metaphor, introduced earlier (see section 1.4.1), discussing the relationship between

conceptual metaphor and cross-domain mapping in more detail before considering how such metaphors and mappings show themselves in co-speech and co-singing gestures.

In *Metaphors We Live By* (1980), Lakoff and Johnson presented the theory of conceptual metaphor, arguing that metaphor is not merely a characteristic of language, but rather is fundamental to our way of thinking about the world (1980, p. 3). In their view, verbal metaphors arise from our accumulated embodied experiences and interactions with our physical environment. For example the conceptual metaphor 'Happy is Up, Sad is Down', which leads to verbal constructions such as 'high spirits' or 'feeling down', draws on our physical experiences of happiness being associated with an erect posture, and sadness linked to a drooping posture (Lakoff and Johnson 1980, pp. 14-15). Based on a substantial assemblage of such evidence, they state that 'no metaphor can ever be comprehended or even adequately represented independently of its experiential basis' (1980, p. 19).

In Lakoff and Johnson's later publications, cross-domain mapping formed through correlations in our perceptual experiences is explicitly presented as a basis of conceptual metaphor (Lakoff 1993, and Johnson 2007).[40] For example, Lakoff (1993) describes metaphor as a 'cross-domain mapping in the conceptual system' and metaphorical expression as 'the surface realization of such a cross-domain mapping' (1993, p. 203). Such definitions demonstrate the tight connection between conceptual metaphor and cross-domain mapping. Viewed from a conceptual metaphor perspective, metaphoric expressions used by music teachers when verbally correcting students, such as instructions that the music should 'flow', or that the student should 'give weight' to a *svara*, are based on cross-domain mappings and correlations in experience. Similarly, metaphoric gestures, which will be discussed at length in the following sections, are also based on such cross-domain mappings and correlations in experience. Therefore, this chapter aims to elucidate the various cross-domain mappings that lie behind the co-singing gestures of Karnatak vocal teachers, and discern their bases in embodied experience. First, however, it will be necessary to consider metaphoric gestures in more detail. It should be noted that in the remainder of this thesis, the term 'metaphor' is used to refer to 'conceptual metaphor' based on correlations in experience and cross-domain mappings as defined by Lakoff and Johnson in the works cited above.

7.3 Target and source domains in co-singing gestures

In order to understand how co-singing gestures might be regarded as metaphoric modes of communication it is useful to consider the mechanism through which conceptual metaphor

[40] See section 6.3 of this thesis for an overview of cross-domain mapping involving the auditory domain.

functions. Lakoff (1993) describes conceptual metaphors as mappings across conceptual domains that 'allow us to understand a relatively abstract or inherently unstructured subject matter in terms of a more concrete, or at least more highly structured subject matter' (1993, p. 245). The 'relatively abstract' subject matter is commonly referred to as the 'target domain', and the 'more concrete' element, as the 'source domain' (Johnson 1987; Lakoff 1993). For example, in the case of the metaphor connecting musical pitch and vertical position in space, the relatively abstract concept of musical pitch is mapped onto the more concrete concept of position: pitch is the target domain and position is the source domain. As discussed in chapter 6, this particular metaphor is derived from the cross-domain mapping between pitch and vertical position which may arise from our accumulated embodied experience and interaction with our physical environment (Dolscheid et al. 2013). The results presented in chapter 6 demonstrated that this mapping could be seen to various extents in the gestures of the three teachers whose lessons were analysed.

In addition to the metaphor connecting musical pitch to vertical height, other metaphors and associated cross-domain mappings can also be seen in gestures produced by Karnatak vocal teachers. During a follow-up interview conducted while watching the video recording of a lesson made several months beforehand, T.V. Ramanujacharlu (hereafter TKV) stated that a gesture in which he used a fist handshape and engaged in an effortful stretching action was suitable for a particular phrase, because 'weight should be there' (TKV, personal interview, Srirangam, August 16, 2014). The gesture discussed at this point of the interview can be seen in Figure 7.1 (Media File 7.1). Musicians will recognise the metaphoric use of the word 'weight' as one commonly encountered in music-related talk; a request from a teacher to add 'weight' to a note would imply that it should be made more important or prominent through a combination of loudness, fullness of tone, and perhaps also by increasing the duration of the note. These are all musical qualities required at certain points of the phrase being corrected by TKV while using these effortful gestures (see Media File 7.1). The metaphoric use of the word 'weight' could be based on a number of perceptual correlations, including experiences of heaviness as being perceptually prominent compared to experiences of lightness. The origins of the 'importance is weight' metaphor have been tested and discussed in Jostmann et al. (2009), where it was found that the abstract concept of importance is grounded in bodily experiences of weight. In the context of the Karnatak vocal lesson discussed, the cross-domain mapping underlying the metaphoric use of the term weight to refer to musical sound can, therefore, be viewed as based on a mapping between physical force (weight) and musical prominence, achieved in this case through loudness and extended duration. Here, physical force is the more concrete 'source domain', and musical prominence is the more abstract 'target domain'.

Figure 7.1: TKV sings a phrase accompanied by a two-handed pulling or stretching gesture (Media File 7.1).

Another cross-domain mapping observed in experiment-based research that could be relevant to TKV's gesture, is that which has been found between increase in loudness and the application of external force (Eitan and Granot 2006; Eitan and Tubul 2010). In the latter study, the authors propose that the relationship between crescendo and force is based on our physical experiences, accumulated since childhood:

> In hitting a surface, or clapping hands, children may learn that larger and faster movements (gaining more kinetic energy) would generate a more forceful impact, and thus a louder sound. Hence, both the speed of movement and its magnitude (which itself correlates with height) are embodied into the percept and concepts of loudness. (Eitan and Tubul 2010, p. 103)

While a discussion of metaphor in musical gestures and music-related speech affords the dissection of the relationship between gesture and music into components such as physical force and musical emphasis, there is undoubtedly more being conveyed through TKV's effortful gestures seen in Figure 7.1 than a simple indication of prominence, loudness, and duration. There is also a sense in which the gesture as a whole, its particular patterning of effort and emphasis, is iconic of the 'musical motion' of the phrase. Therefore, in this chapter I will approach the analysis of gesture in lessons from two perspectives, the first identifying some of the more or less discrete mappings between gesture and music, such as that between physical effort and musical emphasis, and the second viewing the relationship between gesture and music more holistically, with gestural movement considered iconic of musical motion. In order to clarify this distinction, the relationship between metaphor and iconicity in gesture will be elaborated on in the following section.

7.4 Metaphor and iconicity in gesture

Metaphoric gestures that accompany speech have been discussed extensively in the wider field of gesture studies. They appear as a class of gestures in McNeill (1992) where they are described as 'images of abstractions' in which 'abstract content is give form in the imaginary of objects, space, movement, and the like' (1992, p. 145). An example often cited is the 'conduit gesture' in which a speaker gestures as though holding an imaginary object, referring not to a physical object but rather something abstract, such as a memory or an idea. McNeill (1992) gives the example of a conduit gesture in which a speaker announces the subject under discussion, which in this case is a genre of cartoon, while gesturing as though presenting an imaginary object held in his hand (1992, p. 14). Here the abstract concept, a genre of cartoon, is made more concrete through this metaphoric gesture. As will be shown in the present chapter, Karnatak vocalists employ a range of holding, pinching, and tracing gestures, all of which could, in the sense used by McNeill, be described as metaphoric gestures, because the imaginary object being held or traced is not a physical object but rather the music.

Importantly, in addition to the metaphoric content of such gestures there is also an iconic component (McNeill 2005, p. 39). Iconic gestures are described by McNeill as movements that 'present images of concrete entities and/or actions' (2005, p. 39). In metaphoric gestures, the concept behind the gesture is metaphoric; for example, in McNeill's example, the imaginary physical object being held is a metaphor for the abstract concept under discussion. However, the gesture also includes an iconic component, as it presents the image of a concrete action, which in this case is the act of holding and presenting an object (McNeill 2005, p. 39). Cienki (2008) expands on this iconic element in metaphoric gesture, observing that metaphoric gestures represent the source domain of a metaphor iconically (2008, pp. 8 and 21). In the context of Karnatak vocal pedagogy, this relationship can be illustrated using the example discussed in sections 5.3.2 of this thesis in which first T.S. Sathyavathi (hereafter TS) and then her student, Ashwini Satish (hereafter AS), performed downward hand motions while singing motifs with downward pitch movement. In this case, the gestures refer to the metaphor connecting musical pitch and vertical position wherein a pitch can be described as 'lower' or 'higher' than another. In addition to this metaphoric mode of communication, the gestures also have an iconic element: the concrete action of downward motion referring to the 'downward' movement in pitch. Here, the relationship between pitch and height is metaphoric, while the relationship between the height of the hand and the height of the pitch is iconic. In effect, the gesture is an iconic enactment of a conceptual metaphor, and, as described by Cienki (2008), the gesture enacts the source domain (vertical position) of the metaphor, iconically.

Gestural indexing of musical qualities other than pitch may be similarly viewed as combining metaphoric and iconic modes of communication. This can be seen, for example, in TS's demonstration of a pressing gesture that she explained as indicating musical 'pressure' or 'stress', discussed in section 5.3.5 of this thesis. Here, the words 'pressure' and 'stress' are used as metaphors for musical emphasis. This connection likely arises from an underlying mapping between increase in loudness and increase in force applied (Eitan and Granot 2006; Eitan and Tubul 2010), a mapping that is formed through accumulated physical experience of interaction with objects and sounds. Considered as a conceptual metaphor, stress or physical pressure is the source domain, and the quality of musical emphasis is the target domain. The relationship between pressure/stress and musical emphasis can be regarded as metaphoric, while the relationship between the gesture (an enactment of pressing) and the source domain (pressure/stress) is iconic. Therefore, also in this case, the gesture enacts the source domain of the metaphor iconically.

7.5 Iconicity and musical motion

In addition to the combined metaphoric and iconic explanation of co-singing gestures presented above, there is at least one sense in which co-singing gestures may be viewed as primarily iconic. If 'musical motion' is understood not as a metaphor but rather as something actually experienced, as argued in section 1.5 of this thesis, then co-singing gestures may also be interpreted as iconic of such musical motion. Ecological accounts of music perception have proposed that when listening to music, we experience something of the motions that create sounds (see section 1.5.3), as well as the movement of virtual sources implied by dynamics and timbral change (section 1.5.2) (Clarke 2001; Windsor 1995; Shove and Repp 1995). Therefore, there is a case to be made that the gestures observed in Karnatak vocal lessons are iconic of such experiences of musical motion. Vocal teachers are perhaps exemplifying the type of motion that they wish both their own and their students' performances to engender.

If co-singing gestures are considered to be iconic of musical motion, and experiences of musical motion arise, in part, from musicians' sound-producing gestures, it follows that vocal teachers' gestures will sometimes be iconically related to aspects of the physical motion required to sing the phrase. For example, TS's pressing gesture (see section 5.3.5) relates iconically, although through different effectors, to the muscular effort involved in producing emphasis in the voice or, equally, a sudden increase in hand pressure on a violin bow. Supporting such an interpretation, one of the students interviewed during my research, Madhuri Kaushik (hereafter MK), frequently referred to gestural movement as connected to

the vocal effort required to produce the music (see section 5.3.8), while, in addition, TS noted that gestures could show where more 'breath' was required (section 5.3.5).

It is possible that such connections between vocalists' sound-accompanying and sound-producing gestures are supported by 'motor equivalence', as suggested by Godøy (2010, p. 109; 2013, p. 17). Motor equivalence is the mechanism through which we are able to accomplish the same goal using different effectors, for example writing a name with a pencil held between the toes or teeth (Kelso et al. 1998). While there are a number of theories competing to explain how this occurs, the practical result of the phenomenon is that when one part of the body is unavailable, another part is immediately able to perform a similar patterning of effort, direction, and timing in movement. Following from this, the suggestion in the present context is that motions used to sing a motif may easily emerge through motor equivalence in the hand gestures of singers. This is not to imply that all sound-producing motions can be seen in hand gestures, but rather that motor equivalence affords the possibility of such a connection occurring, perhaps only actually emerging at certain moments.

In summary, it is possible to view co-singing gestures both as metaphoric and iconic forms of communication. Co-singing gestures may be understood as metaphoric in nature, due to their tendency to portray music as an object to be grasped, pinched, thrown, or pointed to. In addition, specific musical qualities such as loudness, emphasis, and pitch may be alluded to metaphorically through gesture or words; for example, in the mappings discussed above between importance (prominence) and weight (Jostmann et al. 2009), and increase in loudness and the application of external force (Eitan and Granot 2006; Eitan and Tubul 2010). However, co-singing gestures may equally be viewed as iconic of the 'musical motion' that the teacher wishes the phrase to convey, created through patterns of emphasis, dynamics, attack, release and change in timbre. Finally, vocalists' hand gestures may also be regarded as connected to the physical movements required to sing the phrase. I suggest that these different accounts of co-singing gesture do not exclude each other, but rather highlight different aspects of the same fundamental connection between physical movement and sound.

In the next section, the questions of what is indexed by co-singing gesture and how this is achieved will be discussed further, with reference to existing literature on gesture in musical contexts.

7.6 Gesture, metaphor, and analogy in musical contexts

Discussions of metaphor and analogy have featured in previous studies of music and gesture, the most relevant of which are Leante (2009, 2013), Fatone (2010), Fatone et al. (2011), and Rahaim (2008, 2012). Here, I will critically review the approaches to metaphor and meaning seen in these texts.

Drawing on her experience of learning to perform a style of Scottish bagpiping known as *pìobaireachd* in Atlantic Canada, Fatone (2010) enquires into her various teachers' use of co-playing gestures, 'conducting gestures', and verbally expressed metaphoric images of object or body motion (p. 403). In particular, Fatone asks why she sometimes experienced greater insight into her teachers' intent through their use of 'non-aural images' (conveyed through gesture and language) than when they simply played a phrase (p. 406). Hand gestures made by Fatone's teachers while either listening to her play or giving verbal explanations included stretching and circular motions. Fatone describes such gestures as iconic, in which 'the gesture resembles the physical aspect of its referent (in this case musical motion) in some way (2010, p. 409). Fatone's position is, therefore, akin to the iconic interpretation of gesture discussed in section 7.5 of this thesis, wherein teachers' gestures are viewed as iconic of the musical motion that they wish to convey to their students.

In her analyses of gesture in North Indian vocal contexts, Leante (2009; Fatone et al. 2011) takes a related but somewhat different approach to that of Fatone (2010), instead characterising co-singing gestures as connected to kinetic analogies expressed by music. Here, Leante draws on the work of Tagg (1999, 2013) who coined the term 'kinetic anaphone' to refer to a musical event that is analogous to motion in humans, animals and objects. The identification of 'anaphones' (sonic analogies) forms part of Tagg's wider goal to identify minimal units of meaning in music (1999, p. 33). For Leante, the kinetic analogies present in music can be mirrored by gestures that express the same analogy (Fatone et al. 2011). Examples given of gestures that communicate qualities of musical movement include several co-singing gestures produced by North Indian vocalists while teaching, including one that follows the trajectory of a bouncing ball, and another in which the teacher ties an imaginary knot (Fatone et al. 2011, pp. 209-211). Leante takes the position that such gestures clarify the musician's idea of the music:

> The gesture accompanying the performance of these anaphones is a way to embody, and at the same time to project, the meaning and the image the musician associates with it. (Fatone et al. 2011, p. 210)

Leante's approach, using kinetic anaphones, allows for the musical motion experienced to be non-human in origin, as is the case in the bouncing ball gesture discussed in Fatone et al. (2011). Fatone (2010) also discusses qualities of musical motion that are non-human in origin, arguing that accounts available in the field of embodied music cognition emphasise the matching between human movement and music, but fail to fully account for the 'seemingly automatic, cognitive matching of music to inanimate objects in motion' (2010, p. 415). In the analyses that follow later in this chapter, I give several examples of Karnatak vocal teachers'

gestures that are best described as conveying qualities of object motion. I would suggest that the connection between musical motion and non-human motion referred to by Fatone (2010, p. 415) can be explained through an ecological account of music perception in which music creates the illusion of moving sound sources (see 1.5.2), affording the expression of both human and non-human motion through music. Such issues will be discussed further as this chapter progresses.

Like Leante (2009), Rahaim (2012) examines gesture in North Indian vocal performance and teaching contexts. However, unlike both Fatone and Leante, Rahaim avoids discussion of iconicity and analogy in gesture, and instead argues against viewing gestures as 'metaphoric representations of sound' (2012, p. 50). As Rahaim's position regarding metaphor differs from my own approach, I will discuss his argument at some length, the main part of which can be viewed in the following extract:

> Ordinarily, we might assume that this motion [gestural motion] is merely a metaphoric representation of the sound (see Johnson 2007: 248). And to be sure, in a few special cases, singers sometimes do imagine notes and represent these notes with their hands. For example, a teacher may deliberately "sketch" notes in the air along a clearly delineated linear axis for the sake of a student who repeatedly fails to reproduce the pitch sequence of a phrase. […] Apart from these special, distinctive cases, however, there is no evidence that the spontaneous flow of gesture in the course of masterful singing *represents* vocalization in general. (Rahaim 2012, p. 50)

Here, Rahaim appears to dismiss metaphoric approaches to the interpretation of gesture (a similar argument is presented in Rahaim 2008). However, I would suggest that much of his disquiet is due to his attribution of 'representation' and deliberate action to metaphoric modes of gestural communication. For example, in the long quote above, Rahaim does not speak simply of metaphor, but rather 'metaphoric representation', and his attribution of deliberate action to metaphoric representation can be seen in his use of the word 'deliberately' when describing the 'special cases' in which metaphoric representation does occur: 'a teacher may deliberately "sketch" notes in the air' (2012, p. 50).

I would agree with Rahaim that the gestures used by Indian vocalists are not deliberate 'representations' of the sound. However, I argue that this does not preclude them from constituting metaphoric modes of communication. Neither conceptual metaphor as defined by Johnson (2007), whom Rahaim cites, nor metaphoric gestures as described by McNeill (1992), involve representation or deliberate effort on the part of those who produce them: Johnson (2007) argues at length against representational theories of mind and cognition (2007, pp. 113-134), and the metaphoric gestures discussed by McNeill (1992) are

spontaneous. I would argue instead that gestures used by Indian vocalists are often metaphoric, conveying one thing (for example, musical emphasis or pitch), in terms of another (physical motion); but I would suggest that this is done without any deliberate act of representation being made by the vocalist.

Furthermore, I concur with Rahaim that it is not primarily vocalisation that can be seen in the gestures (p. 50). The fact that gestures may continue when vocalisation stops and that they tend to occur slightly ahead of sound produced suggests rather that gestures map onto the vocalist's idea of the music and its production: that entirety of physical and mental effort required to will a phrase into being. In conclusion, while I agree with Rahaim that gestures are not deliberate representations of vocalisation, I argue that they reveal conceptual metaphors and cross-domain mappings between movement and sound, and that these may be communicated to the audience or student as a result.

Before proceeding to my analyses of metaphor and iconicity in Karnatak vocal lessons, I will discuss some pertinent research on conductors' gestures, which includes interesting parallels to the present context.

7.7 Conducting gestures

Prior to embarking on this discussion of research on conducting gestures, I should clarify that the gestures produced by teachers in Karnatak vocal lessons cannot be viewed as a form of conducting. Although teachers do sometimes gesture while their students sing, this mode of gesturing is far less common in lessons than co-singing gestures, which teachers produce almost continuously while demonstrating *rāga ālāpana* phrases to their students. Furthermore, when teachers do gesture while a student sings, there is no formal context to the gesturing: there is neither expectation that teachers should 'conduct' at such moments, nor formal requirement that students should follow their movements as would be the case, for example, in orchestral conducting. Rather, the gestures are better viewed as spontaneous movements arising from the teacher's desire to communicate their idea of how the phrase should be sung. However, the research on conducting gestures discussed in this section is relevant to the issue of metaphor and iconicity in co-singing gestures, and so is worth elaborating on here.

In Bräm and Boyes Braem (2001), the authors examine gestures observed in orchestral conductors' non-beating hand, using two video recordings of well-known conductors as data for their analysis. In this study, such gestures are interpreted as metaphoric, and characterised as similar to gestures found in spoken language (2001, p. 14). Similarity is noted between handshapes observed in conductors' gestures, and those used in deaf sign languages, and the analysis presented draws on categories inspired by sign language

handshapes. In addition, the authors discuss types of metaphoric gestures involving object manipulations and other actions.

Bräm and Boyes Braem (2001) argue that while any given gesture or handshape is polysemous in nature, meaning that it may convey several different meanings, it does not follow that a particular handshape may be used in any situation: 'One would not use a 'fist' handshape, for example, to accompany a meaning that had to do with 'small, fine detail', 'precision', and so forth' (2001, p. 16). Bräm and Boyes Braem's position here is that polysemous gestures are constrained by conceptual metaphor, as defined by Lakoff and Johnson (1980), and they view conducting gestures as based on a number of fundamental conceptual metaphors:

> The gestural space of the conductor is like a small stage, on which the actors are the conductor's hands, body, face and eye gaze, all of which play out specific aspects of the musical score through the indication of basic metaphors. (Bräm and Boyes Braem 2001, p. 17)

Bräm and Boyes Braem (2001) note that conducting gestures frequently involve actions in which it appears that imaginary objects are being manipulated, which leads them to a discussion of Lakoff and Johnson's (1980) thoughts on the human tendency to communicate abstract concepts through metaphoric structures involving imagined objects:

> We experience many things, through sight and touch, as having distinct boundaries, and, when things have no distinct boundaries, we often project boundaries upon them - conceptualizing them as entities and often as containers. (Lakoff and Johnson 1980, p. 58; quoted in Bräm and Boyes Braem 2001, pp. 16-17)

This tendency to conceptualise something without boundaries (music) through something that has such boundaries (objects) is apparent in some of the categories of gestural actions proposed by Bräm and Boyes Braem, derived from their analysis of orchestral conducting gestures. Their full list of gesture types is as follows:

> (a) Manipulating objects
> (b) Showing the path or form of an object
> (c) Indicating direction
> (d) Portraying an object
> (e) Indicating a body part
> (f) Holophrastic interjections [emblem gestures] (2001, p. 18)

As already discussed in this chapter, authors including Leante (2009) and Fatone (2010) have noted that gestures produced in music teaching contexts often either appear to manipulate or show the motion of imaginary objects, and such gestures are also apparent in Karnatak vocal lessons. However, when attempting to apply the categories suggested by Bräm and Boyes Braem to Karnatak vocal lessons, I found that only two of their gesture types occurred frequently: 'manipulating objects' and 'showing the path of an object'. Object manipulators observed in Karnatak vocal lessons include actions that mimic stretching, hitting, pressing, and throwing. Gestures 'showing the path of an object' are described by Bräm and Boyes Braem as indicators of musical paths, in which the form of the music is shown either by the index finger or by a flat hand (2001, p. 21). A large majority of the gestures observed in Karnatak vocal lessons would fit in such a category, as the vocalist's hand typically continuously traces dynamic shapes in space that indicate the path of the music. Therefore, although it is interesting to note the points of similarity between orchestral conducting gestures and Karnatak co-singing gestures, the prevalence of this category in the present context makes it of little use for analysis.

A more useful distinction that can be made between gestures observed in Karnatak vocal lessons is one based on the relationship between object and agency seen in the various actions (see Table 7.1). In addition to 'object manipulations' in which the vocalist's hand appears to manipulate an imaginary object, two other categories might be proposed: 'object motion' and 'self-generated motion'. Object motions appear to mimic the action of objects that have been subject to manipulation; for example, the rebound of a spring or elastic after it has been stretched, or the falling of an object that has been thrown in the air. Such gestures not only show the path of an object in motion, as suggested by Bräm and Boyes Braem (2001), but also convey the quality of that motion. The category 'self-generated motion' covers actions that are not 'object manipulations' but that appear to be self-generated rather than caused by external force. Within this class are gestures that swoop, dab, and flick, as well as those that indicate paths in space without any object manipulation or object motion implied. Table 7.1 lists these three broad types of gesture observed in Karnatak vocal lessons, alongside some of the actions that fall into each type. It should be noted that more than one of these types of gesture may occur during a single musical phrase; an 'object manipulation', such as a stretching action, may be immediately followed by an 'object motion' (for example, a rebound), and continue directly on to a 'self-generated motion' (for example, a swoop).

Broad gesture types based on relationship between object and agency	Corresponding actions
Object manipulation	Stretching, hitting, pressing, throwing
Object motion (movement of an object resulting from manipulation)	Rebound, oscillation, falling
Self-generated motion (not involving object manipulation)	Swoop, dab, flick, tracing

Table 7.1: Broad gesture types based on the relationship between object and agency observed in gestures in Karnatak vocal lessons, together with corresponding actions.

In addition to referencing these three broad categories of hand motions, my analysis in this chapter will also refer to some of the individual conducting gestures observed by Bräm and Boyes Braem, which in many cases are similar both in form and meaning to those found in Karnatak vocal lessons. These include gestures defined as, 'taking out of view', 'pushing an object', and 'hitting an object' (2001, pp. 18-21). The 'taking out of view' gesture described by Bräm and Boyes Braem involves a movement 'out of the conducting space', for example below the waist or to the side. In the Karnatak vocal lessons analysed here, TS frequently uses a 'taking out of view' gesture, in which her hand moves sharply back towards her body, out of the primary gesture space. Bräm and Boyes Braem note that conductors seem to have their own 'trademark' 'taking out of view' gesture (p. 19), and the same can be seen in Karnatak vocal lessons, with TKV tending to simply place his hand down just before the end of the phrase, while SV frequently pulls her hand back sharply either towards her body or downwards out of the main gesture space.

Bräm and Boyes Braem (2001) describe 'pushing an object' gestures as those that appear to as push the sound to coincide with the point at which playing or an attack begins, also showing how strong the attack should be (p. 21). Similarly, the pressing gesture demonstrated by TS that has been discussed previously in this chapter was timed to coincide with the point in each motif at which musical 'stress' should occur. Pressing gestures can be seen frequently in the lessons of all three Karnatak vocal teachers observed here, while the 'hitting an object' gesture, described by Bräm and Boyes Braem as used for a 'hard/precise or heavy sound quality' (p. 21) was used most often by TKV. Such gestural actions will be discussed further in the analysis section later in this chapter, in addition to other actions not mentioned by Bräm and Boyes Braem. It can be seen from the brief discussion here, that musical qualities linked by Bräm and Boyes Braem to conducting gestures (for example, pushing or pressing to show musical attack), share similarities with those mentioned by Karnatak vocal teachers when discussing comparable gestural actions. This speaks to the extent that both orchestral conducting gestures and the co-singing gestures in Karnatak vocal

lessons draw on conceptual metaphors and cross-domain mappings, which while not necessarily universal, can be found across many cultures.

When discussing handshape in co-singing gestures, I will use a simplified version of those observed by Bräm and Boyes Braem in orchestral conductors. The names they give to the handshapes are taken from those used for similar hand postures in deaf sign languages (see Figure 7.2).

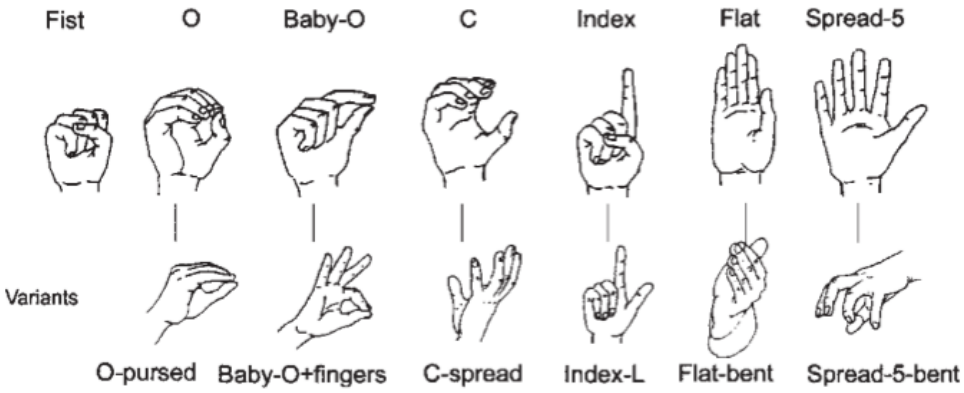

Figure 7.2: Handshapes observed in conductors' gestures - from Bräm and Boyes Braem (2001).

When analysing the recordings of Karnatak vocal lesson I found that a simplified set of handshapes was sufficient, an approach that also reduced difficulty in determining which of two similar handshapes best fitted the gesture observed. My categories derived from Bräm and Boyes Braem (see Figure 7.2) are as follows:

1) **Pinch**: all handshapes in which one or more fingers are pressed at the tips against the thumb, including: 'O', 'O-pursed', 'Baby-O', and 'Baby-O+fingers' (see figure 7.2)
2) **Cup**: all handshapes in which the hand is open, ranging from cupped to almost flat (no completely flat handshapes were observed in the lessons) with fingers either spaced apart or held together, including: 'Flat-bent', 'Spread-5', Spread-5-bent'
3) **Point:** all single-fingered and two-fingered pointing handshapes, including: 'Index', and 'Index-L', as well as a two-fingered pointing gesture not listed by Bräm and Boyes Braem
4) **Fist**: includes both tight and loose 'Fist' handshapes

A number of underlying metaphors linking these handshapes to musical qualities will be briefly discussed here, and elaborated on further during the analysis section of this chapter.

Bräm and Boyes Braem (2001) observe that different handshapes are suitable for grasping or holding different types and sizes of objects, with the 'fist' handshape used for

heavy objects, 'Baby-O' (pinch) used for small, light, and thin objects, and 'C-spread' (cup) used for fairly large, roundish objects (p. 16). In the context of Karnatak vocal lessons, I suggest that the size and other qualities of the imaginary object grasped, as implied by the vocalist's handshape, are metaphoric of the musical qualities expressed at that point. The fist handshape, for example, would be used in everyday life to move a heavy object, an action that is likely to be perceptually prominent due to the effort required to complete it. This mapping based on everyday experience is perhaps one of the reasons that the fist handshape in vocal lessons often co-occurs with musical qualities such as emphasis and loudness, which are prominent perceptually and also require relatively more effort to perform. The connection between handshape and musical weight was acknowledged by TKV when he explained that a fist handshape was more suitable for a phrase that required loudness and a full tone than a 'pinch' handshape (TKV, personal interview, Srirangam, August 11, 2014).

While the musical associations of the fist handshape appear clear (loudness, full tone, prominence), similarly distinct associations for the other three categories of handshape outlined above are more difficult to identify. In the lessons analysed, 'pinch' handshapes were often used for soft sustained tones, but they also co-occurred with melodic sequences of moderate loudness and emphasis, as did both the 'point' and 'cup' handshapes. Bräm and Boyes Braem characterise 'pursed' (pinched) handshapes as emblematic of focus (2001, p. 25). However, pinch handshapes are so frequently used in Karnatak vocal lessons that this emblematic meaning is unlikely to be communicated, apart from perhaps providing a general reminder to the student to be focused and precise in their rendition.

Handshapes observed in Karnatak vocal lessons were often integral to the type of action used to end a phrase. For example, TS sometimes performed an action at the end of phrases in which an imaginary object held in a 'cup' handshape was placed carefully down, while the release gesture she frequently used at the end of phrases typically employed a 'pinch' handshape that was subsequently released. In these cases, the handshape is implicated in the quality of articulation and type of release used at the end of the phrase. Specific examples will be discussed in the analysis section later in this chapter, in order to provide insight into what is indexed by handshape in this context.

7.8 Defining musical and gestural qualities

7.8.1 Musical qualities

Many of the musical qualities discussed in this chapter are perceptual qualities that cannot be easily measured using quantitative techniques. Furthermore, there is no standardised list of

such qualities employed in music analysis. Therefore, in order to ease comprehension of the analysis that follows, I present the following list of terms and definitions:

1) **Duration**: the length of time for which a pitch is held
2) **Loudness**: perceived loudness - sometimes referred to as 'dynamics'
3) **Timbre**: related to the sound's spectral characteristics - implicated when referring to qualities such as fullness or thinness of tone
4) **Musical shape**: a metaphor often used when referring to patterns created by changes in loudness and timbre
5) **Attack and release**: the qualities of sound at the onset and end of a sonic event - related to the term 'articulation'
6) **Emphasis**: sudden increase in loudness or change in timbre
7) **Smoothness / jerkiness**: the quality of movement between consecutive pitches within a section of a phrase

7.8.2 Qualities of gesture

Although gestural qualities, like musical qualities, are difficult to define, there have been attempts to specify action types and qualities of effort in the field of dance, notably in the work of Rudolf Laban. In *Mastery of Movement* (1971), Laban presented several typologies of movement, two of which, 'basic actions' and 'effort descriptors', have been employed by researchers studying gesture in musical contexts (for example, Broughton and Stevens 2012; Broughton and Davidson 2014; Haga 2008; Maes et al. 2014a). A summary of Laban basic actions (punch, press etc.), and associated effort descriptors (weight, time, space) is presented in Table 7.2 (derived from Laban 1971, p. 77-85). The basic action types suggested by Laban will not be used in the analysis that follows in this chapter, as many gestures seen in Karnatak vocal lessons fall outside of the categories presented. However, some of the Laban effort descriptors are useful for describing co-singing gestures, in particular the heavy-light and sudden-sustained dichotomies (see Table 7.2). These will, therefore, be employed when defining some of the gesture actions observed.

Basic action	Derivatives	Weight	Time	Space
Punch	Shove, kick, poke	Heavy	Sudden	Direct/Straight line
Press	Crush, cut, squeeze	Heavy	Sustained	Direct/Straight line
Slash	Beat, throw, whip	Heavy	Sudden	Flexible/Wavy line
Wring	Pull, pluck, stretch	Heavy	Sustained	Flexible/Wavy line
Dab	Pat, tap, shake	Light	Sudden	Direct/Straight line
Glide	Smooth, smear, smudge	Light	Sustained	Direct/Straight line
Flick	Flip, flap, jerk	Light	Sudden	Flexible/Wavy line
Float	Strew, stir, stroke	Light	Sustained	Flexible/Wavy line

Table 7.2: Laban basic actions and effort descriptors – derived from Laban 1971, pp. 77-85

7.9 Analysis

7.9.1 Introduction and methods

This section presents an analysis of mapping, metaphor, and iconicity in co-singing gestures produced by teachers during the same three Karnatak vocal lessons analysed in chapter 6. The aim of this analysis is to provide insight into how particular musical qualities are indexed by gesture in this context, and to afford discussion of how such indexing supports the learning process.

The method followed in this analysis was to first identify a set of commonly occurring gesture actions through repeated viewing of the lessons, drawing on some of the effort descriptors and basic actions presented by Laban (1971). In order to better define the gestures observed, I treated the effort descriptors more as continuums than as dichotomies. The 'basic actions' and associated effort descriptors observed in the vocal lessons analysed are presented in Table 7.3.

Basic action	Weight	Time	Space
Stretch/pull/push	Heavy	Sustained	Direct
Yank/hit	Heavy	Sudden	Direct
Flick/throw	Light to medium	Sudden	Flexible
Dab/press	Light to medium	Sudden	Direct
Glide/swoop	Light	Sustained	Direct
Tracing	Light to medium	Sustained	Flexible or direct

Table 7.3: Gesture actions observed in Karnatak vocal lessons together with corresponding effort dimensions modified from Laban (1971)

In the lessons examined, the gestures that co-occur with a single phrase frequently include several of these basic actions, making exhaustive coding with such types excessively complex. Instead, these basic actions will be considered in the context of specific pedagogic interactions, along with a discussion of their associated musical qualities. Trouble spots, points in the lessons where the teacher attempts to correct student error, will frequently be used in my examples, as at these points we have some insight into the teacher's communicative intent, namely conveying the solution to the student's error. It is, therefore, easier at such moments to gain insight into how gesture contributes to the pedagogic process. In this analysis, I will describe the student's error based on my own assessment of the interaction and also, where available, the comments of the teacher obtained during follow-up interviews. In each case, the musical qualities indexed by the basic actions will be discussed in addition to the metaphors, cross-domain mappings, and perceptual correlations on which they are based. The findings of this analysis will be presented teacher by teacher, in order to highlight their individual gesturing styles.

7.9.2 TKV and 'weight'

Of the three teachers whose lessons are analysed here, TKV makes the most use of stretching, pulling, and yanking actions, which, through their use of force, give the impression that something heavy or firm is being manipulated. In Laban effort terms, such actions would be considered as 'heavy', defined as showing a strong resistance to weight (Laban 1971, p. 81). TKV's student in this lesson was at relatively early stage in her learning process, and had limited awareness of the emphases and qualities of motion required in the phrases being taught. TKV, therefore, made frequent use of gestures that might help her grasp such musical qualities. Several examples of stretching, pulling, pushing, and yanking motions will be discussed here.

(i) Stretch/pull/push: single and double-handed

[Media File 7.2]

This trouble spot has been briefly considered earlier in this chapter with regard to the quality of musical weight (see section 7.3). Here, the pedagogic interaction will be discussed in full, in order to gain further insight into the musical qualities indexed by the teacher's gestures.

The student's errors that are corrected by TKV in this interaction lie in the section of the phrase comprising the *svaras 'pa-dha-dha-pa'* (see Figure 7.3), during which the student repeatedly fails to spend enough time on the long *pañcama* at the start of this sub-phrase, and has difficulty reproducing the correct quality of melodic motion on the '*dha-dha'* figure.

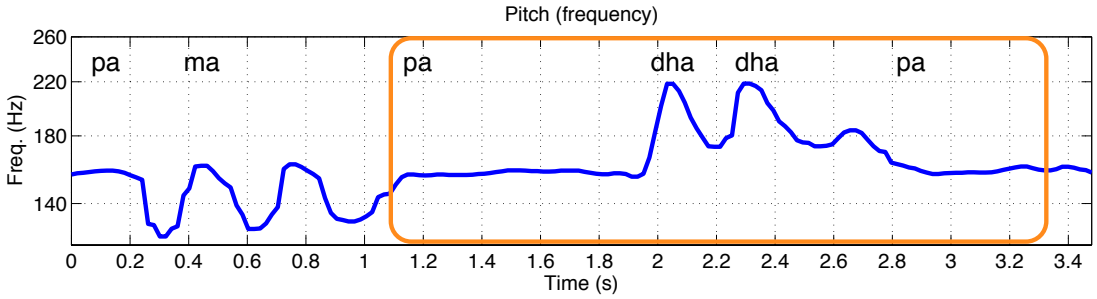

Figure 7.3: Pitch contour for the phrase *pa-ma-pa-dha-dha-pa*, taken from TKV correction phrase 29 (Media File 7.1).

The phrase *'pa-dha-dha-pa'*, is sung by TKV five times during this interaction. In the initial demonstration and first correction phrases it is accompanied by a single-handed gesture with a 'fist' handshape and a downward pushing action (see Figure 7.4 and Media File 7.3, showing TKV correction phrase 28).

Figure 7.4: Single-handed downward push gesture in TKV correction phrase 28 (Media File 7.3).

After the student fails to perform the phrase to his liking, TKV demonstrates the phrase again, this time with a two-handed stretching gesture, emphasising the long *pañcama* (see Figure 7.5 and Media File 7.1, showing TKV correction phrase 29).

Figure 7.5: Double-handed stretching gesture co-occurring with the long *pañcama* in TKV correction phrase 29 (Media File 7.1).

The student makes two more attempts at the phrase, neither of which is accepted by TKV and he provides a new correction after each. The first of these two further corrections is accompanied by the downward pushing gesture, and the second by a sideways stretching gesture (see Media Files 7.4 and 7.5, showing TKV correction phrases 30 and 31 respectively). Throughout these corrections TKV strives to convey information regarding the duration, weight, emphasis, and pitch contour required of each element in the phrase. In particular, the *pañcama* should be long and full in timbre, and the two *dhaivatas* should each be clearly articulated with a gamaka descending from *ṣaḍja*. In addition, TKV aims to convey the quality of musical motion required as the motif unfolds.

The two main gestures used by TKV in his corrections, the pushing and stretching actions, are object manipulators, one of the categories discussed by Bräm and Boyes Braem (2001), in which the gesturer's body acts upon an imaginary object. Both gestures have two components: the 'object manipulation' phase (stretching, pushing) and the enactment of 'object motion' that follows in the rebound and oscillation motions. The stretching and pushing actions share common characteristics: they both enact the type of force that would be required to manipulate a heavy and dense object that has elastic properties. In the stretching action, this application of force can be seen not only in TKV's hand motion but also in his entire upper body as he stoops slightly under the effort involved (see Media File 7.1, showing TKV correction phrase 29).

In section 7.3, I discussed the metaphoric content of the pushing and stretching gestures seen here, concluding that they are connected to the metaphor linking importance (musical prominence) with physical weight (Jostmann et al. 2009), and the cross-domain mapping found between increase in loudness and the application of external force (Eitan and Granot 2006; Eitan and Tubul 2010). In addition to this relationship between forceful pushing gestures and musical emphasis, TKV's gestures in this interaction include another element, namely the rebound motions that follow the stretching and pushing down elements. These rebound motions co-occur with the oscillations forming the svaras, '*dha-dha',* and logically follow from the stretching and pushing motions that precede them: if an elastic object is stretched or pushed down, then a rebound and oscillation will result. There is a sense here in which the gestures are iconic of the unfolding musical motion that TKV wishes to hear in his student's rendition of the phrase: a pressure exerted on *pañcama* followed by a rebound and oscillation. In this particular phrase, however, the oscillation should include clear articulations on each *dhaivata*, and in the last correction, TKV clarifies this with more emphasis placed both in his vocal performance and in his hand motion on the start of the last *dhaivata* (see Media File 7.5, showing TKV correction phrases 31).

(ii) Yank: double-handed

[Media File 7.6]

Several other examples of 'heavy' gestures can be found in TKV's lesson, including another form of two-handed pulling gesture, seen in a correction phrase sung later in the lesson. In this instance he pulls his two hands apart suddenly with a jerk, and, therefore, this gesture would be placed in the action category 'yank', with Laban effort descriptors 'heavy' and 'sudden' (see Table 7.3). The motif with which this gesture co-occurs comprises the *svaras* '*dha-pa-pa'*, sung rapidly and sounding somewhat like a 'turn' ornament in Western classical music.

TKV initially demonstrates the phrase without the yanking motion, using a single-handed gesture with a 'cup' handshape (see Figure 7.6, and Media File 7.7, showing TKV demonstration phrase 51).

Figure 7.6: Single-handed gesture with cup handshape in TKV demonstration phrase 51 (Media File 7.7).

However, on hearing the student's rendition, TKV repeats the phrase with a little more vocal emphasis on the turn-like figure, and a gesture that differs from that used in the initial demonstration. Instead, TKV places his two hands together in front of his chest and pulls them apart sharply to coincide with the figure '*dha-pa-pa'* (see Figure 7.7, and Media File 7.8, showing TKV correction phrase 49).

Figure 7.7: Double-handed yank gesture, co-occurring with the motif *dha-pa-pa* in TKV correction phrase 49 (Media File 7.8). The left picture shows the start of the 'yank' gesture, and the right picture shows the extent of the outward motion before the rebound.

As discussed in the previous example, the 'fist' handshape and forceful movements seen here are metaphoric of musical prominence as they both express heaviness and effort, which through our embodied experience is mapped onto perceptual significance in other domains (Jostmann et al. 2009). In addition, the sharp yanking gesture reflects the cross-domain mapping found between the application of external force and increase in loudness (Eitan and

Granot 2006; Eitan and Tubul 2010). As the gesture is sudden in this case, the increase in loudness here is temporary and appears perceptually as an emphasis on the turn-like figure with which the gesture co-occurs

The initial yank gesture is followed by a rebound motion that links it to a second slightly less emphatic two-handed pull gesture on the motif '*ga-ri-sa*' (see Media File 7.8). Therefore, in addition to showing where points of emphasis lie, there is a sense in which the gestures here are iconic of the unfolding musical motion required: the sudden stretching of an elastic object and the rebound that follows is perhaps analogous to the two musical emphases and the subtle linking *anusvaras* that follow them in each case.

Following TKV's correction, the student does not significantly alter her rendition of the phrase. TKV simply moves on to the next phrase in the lesson, perhaps judging that his student is not at a stage where she can improve her rendition.

(iii) Yank/pull: Single-handed

[Media File 7.9]

The gesture discussed here is a single-handed yanking motion that co-occurs with a relatively emphatic downward pitch movement to *riṣabha* towards the end of the phrase '*ri-ga-ma-ga, ri-sa'*, (see Figure 7.8).

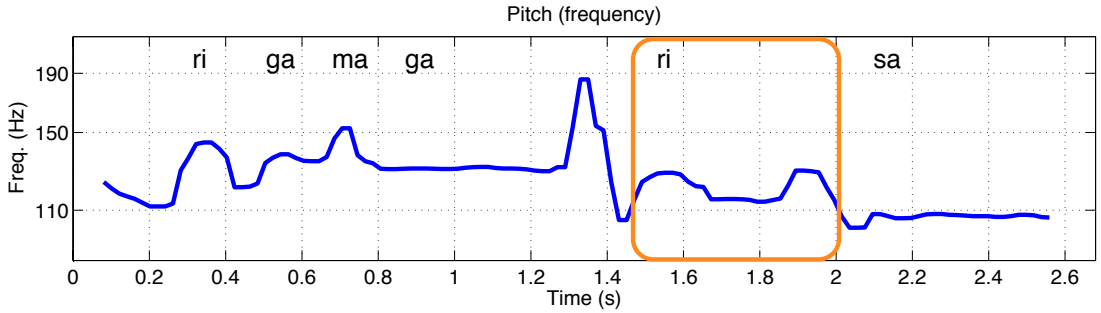

Figure 7.8: Pitch contour plot for the phrase *ri-ga-ma-ga, ri-sa* sung in TKV touble spot 6 (Media File 7.9). The *gamaka* on *riṣabha* is highlighted by the orange box. It starts with a downward movement from *gāndhāra* to *riṣabha*, then rebounds back up to *gāndhāra* before descending to *ṣaḍja* at the end of the phrase.

The yanking gesture does not occur in the demonstration phrase, but can be seen, with variations, in all three of the correction phrases in this trouble spot (see Media File 7.9, showing TKV trouble spot 6). On each occasion the gesture has, in Laban effort terms, a 'heavy' quality, with the time element lying somewhere between the suddenness of a 'yank/hit' action and the more sustained motion of a 'stretch/pull/push' action (see Table 7.3).

In the initial demonstration within this interaction (Media File 7.10), TKV gestures with a relaxed 'fist' handshape, loosely tracing the melodic motion in space, but already

placing a gestural emphasis on the sharp melodic movement down to *riṣabha*. This gestural emphasis can be seen not only in TKV's upward pushing hand movement, but also through his torso and head movement at the same point of the phrase (see Figure 7.9, and Media File 7.10, showing TKV demonstration phrase 17).

Figure 7.9: Single-handed gesture in a loose 'fist' handshape co-occurring with the emphatic melodic motion down to *riṣabha* in TKV demonstration phrase 17 (Media File 7.10). Here TKV's hand pushes forwards and upwards on the downward pitch movement to *riṣabha* and a similar gesture can be seen in his upper body and head at this point. The left picture shows the beginning of this gesture, and the right picture shows the end.

In her imitation attempt, the student makes an error on the *gamaka* used to sing '*ri-sa'*. In *rāga* Śaṅkarābharaṇam, *riṣabha* in this melodic context is performed with a *svara-gamaka* unit that starts at an *anusvara* placed at *gāndhāra*, and then moves down sharply onto *riṣabha,* which is held for a moment. The melodic line then fleetingly leaps upwards before descending to *ṣaḍja* (see Figure 7.8). This melodic movement can be thought of as a *gamaka* on *riṣabha* that includes *anusvaras* on *gāndhāra* at the beginning and the end of the *svara*. The quality of movement with which these *anusvaras* are performed is crucial to the correct performance of this *svara-gamaka* unit: the initial *anusvara* on *gāndhāra* should be strong but very brief, as though a sudden force has pulled it down to *riṣabha*, and the final *anusvara* (the jerk up to *gāndhāra*) is very weak, and should have the motion quality of a rebound up from the downward force placed on the *riṣabha* that precedes it.

In her initial attempt at the phrase, the student fails to understand the *gamaka* used here; she oscillates on *gāndhāra* before descending to *riṣabha*, and, in addition, omits the little jerk up from *riṣabha* before descending to *ṣaḍja*. In order to correct the student's error, TKV sings the phrase again, but this time with a different gesture. In this correction phrase TKV uses a 'fist' handshape, and as he sings the downward pitch movement to *riṣabha* he pulls his hand down and away from his body (see Media File 7.11, showing TKV correction

phrase 11A). Without waiting for the student to imitate the phrase, TKV then sings the phrase two more times, with the gesture varying somewhat on each repetition. In the final correction phrase, TKV makes a particularly sharp downward yanking gesture which then rebounds upward, mirroring the melodic jerk up from *riṣabha* to *gāndhāra* (see Figures 7.10 and 7.11, and Media File 'TKV corr11C'). Here, in addition to mapping pitch to some extent, the gesture indexes the point of emphasis on the movement from *gāndhāra* to *riṣabha*, and is also iconic of the quality of musical motion required throughout the whole phrase, including the subtle rebound up to *gāndhāra*. As in the previous examples discussed in this chapter, the gesture combines both an 'object manipulation' element (yanking something downwards), and an 'object motion' phase (the rebound motion).

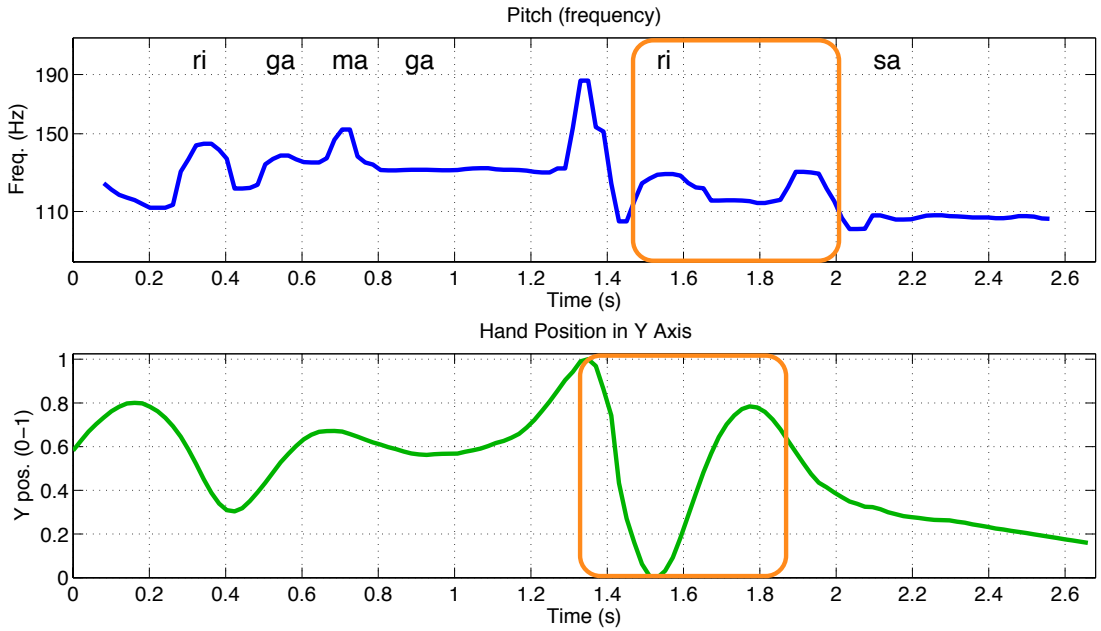

Figure 7.10: Pitch contour (blue line) and y-axis hand position (green line) for TKV correction phrase 11C (Media File 7.12). The orange boxes highlight the sharp downward movement in pitch on *riṣabha* followed by the rebound movement up to *gāndhāra*, and the corresponding downward hand movement and rebound motion that indexes this pitch movement. The leap in pitch at the end of the long *gāndhāra*, and the leap up from *riṣabha* to *gāndhāra* near the end of the phrase are *anusvaras*: extra pitches forming the *gamaka-svara* units used to play the *svaras*.

Figure 7.11: The sharp downward hand motion followed by an upward rebound movement that co-occurs with the *gamaka* on *riṣabha* in TKV correction phrase 11C (Media File 7.12).

In addition to performing this yanking gesture three times during the correction sequence, TKV makes the same action while the student imitates the phrase (see Media File 7.9 at 0'04" and again at 0'14"). Such gestures that are produced by the person who is listening rather than singing will be discussed in chapter 8 of this thesis. Here it is sufficient to note that the yanking gesture and its connection with the quality of musical motion required at the corresponding point in the phrase appears to permeate the teacher's idea of the phrase, manifesting physically both while he sings the phrase and also while he listens to it being sung.

(iv) Hit/yank gesture

[Media File 7.13]

Another gesture with qualities of force and suddenness occurs while TKV teaches the phrase *ga-pa-ma-ma-ri-ga,* shown in Figure 7.12. The *riṣabha* near the end of the phrase is sung with a rapid double oscillation, which TKV accompanies with a sharp downward hitting motion on each repetition of the phrase during this trouble spot (see Media File 7.13, showing TKV trouble spot 8). The Laban effort qualities seen in the hand movement are heavy and sudden, which place it in the category of 'yank/hit' as defined in Table 7.3. This particular 'hit' gesture comprises a sharp downward movement performed with a 'fist' handshape, and co-occurs with the start of the double oscillation that forms *riṣabha*. The hand then rebounds back up coinciding with the melodic movement to *gāndhāra* at the end of the phrase (see Figure 7.12 and Media File 7.14, showing TKV correction phrase 14).

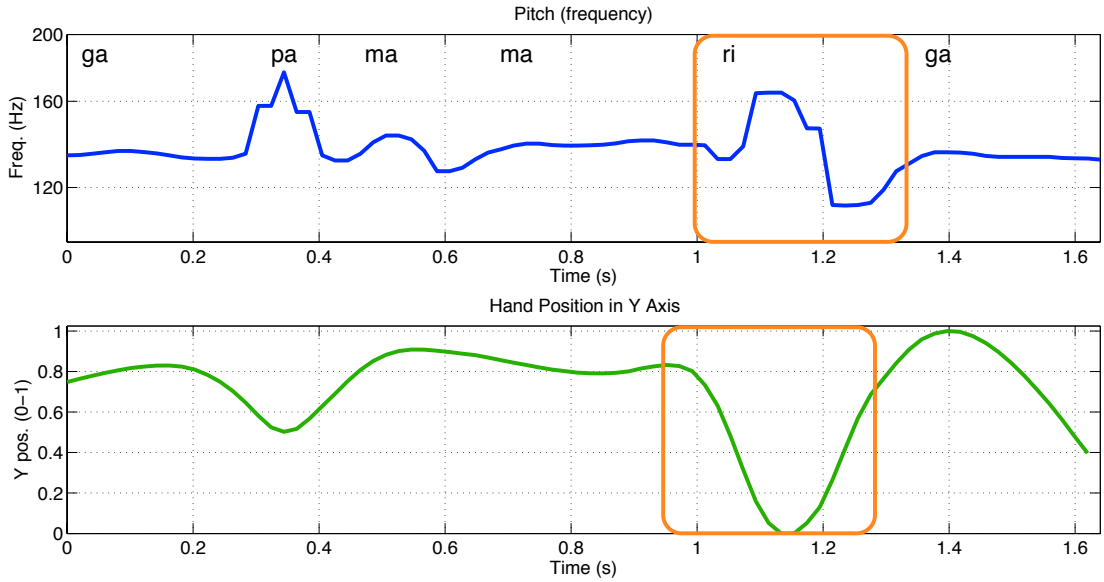

Figure 7.12: Pitch contour (blue line) and y-axis hand position (green line) plots for the phrase TKV correction phrase 14 (Media File 7.14). The orange boxes highlight the double oscillation on *riṣabha* and the down and up hand movement with which it co-occurs.

Throughout this trouble spot, the student has difficulties in imitating the melodic movement of the double oscillation that forms *riṣabha*. In fact, the *gamaka* sung here is not easy to understand; when sung slowly it sounds like a double oscillation (see Media File 7.13 from 0'10" to 0'12"), but when performed at full speed the oscillation can no longer be heard, and only a single emphatic melodic jerk remains (see Media File 7.13 from 0'22" to 0'24"). This effect may be produced either from an extremely rapid oscillation, or by forcing and then obstructing the airflow in the vocal tract producing a kind of musical glottal stop. On the student's first two imitation attempts she sings a double oscillation, but too slowly and without the sudden melodic motion required. Nevertheless, TKV is fairly satisfied with her second attempt (Media File 7.13 from 0'12" to 0'14"), and so he sings a development of the same phrase (0'14" to 0'17"). On this occasion, TKV sings the *gamaka* on *riṣabha* at full speed and the oscillation can no longer be heard. As a result, the student mistakenly interprets the *riṣabha* as a plain *svara*, omitting the jerk quality required in the musical motion. TKV perseveres in helping her understand, singing the phrase several more times and also verbally explaining that there should be more movement on *riṣabha* (Media File 7.13 from 0'27" to 0'30").

Throughout this exchange the teacher uses the downward hit gesture on *riṣabha*, not only when he sings the phrase, but also when his student imitates it, indexing the melodic motion required at that particular point in the student's rendition. It is noticeable that this is the only point during the student's imitations at which he gestures, implying that the gesture emerges due to his desire for this part of the phrase to be performed correctly. Therefore, the gesture here can be regarded as arising from his pedagogic intent. The downward yank/hit

gesture also appears prominently during the verbal correction given by the teacher half way through the trouble spot, in which he explains, using a combination of Tamil and English, that there should be more movement on *riṣabha* (Media File 7.13 from 0'27" to 0'30"). Here, the co-occurrence of the gesture with the verbal correction clarifies the gesture's referent.

In this trouble spot, the teacher's downward hit gesture presents movement that can be viewed as iconic of the qualities of musical motion and emphasis he wishes to hear from the student. His hand movement is rapid with a strong jerk downwards immediately followed by an upward motion returning to the starting point. This physical movement maps onto the qualities of musical motion and emphasis required: a sudden pitch movement down to *riṣabha* performed with an emphatic *gamaka*, immediately followed by a return back up to *gāndhāra*. Here the speed and prominence of the hand movement is mapped onto the musical qualities of duration and emphasis, with emphasis on this occasion being achieved through timbral change due to either a rapid oscillation or a forcing and obstruction of air in the vocal tract. Mapping can, therefore, be seen between hand speed and melodic speed, as well as between emphatic physical movement (jerk, extent of motion, fist handshape) and musical emphasis (sudden timbral change).

The jerk motion is seen not only in the teacher's hand at this point in the phrase, but also in his head movement. This tendency to jerk the head at the beginning of the *gamaka* used to perform *riṣabha* is also seen in the student, with her head movement being faster when her performance of the pitch movement is more rapid. An example of this can be seen by comparing the fast down and up jerk of her head at 0'52" (Media File 7.13) compared to the somewhat slower head motion at 0'26" where she mistakenly performs *riṣabha* as a plain *svara*. The sequence from 0'36" to 0'54" is particularly striking for the way in which TKV's head and body motions appear to attempt to train the student to experience the musical motion required, repeatedly performing the jerk motion throughout his body both while he sings and while his student sings until she achieves a reasonable imitation of the figure in question. I would suggest that the teacher's physical gestures in this trouble spot help the student understand and experience the quality of musical motion required. In addition, it is possible that the physical qualities of the teacher's gestures could provide the student with clues regarding the vocal movement needed to produce the phrase as discussed in section 7.5 of this chapter.

(v) Glide gesture

[Media File 7.15]

In contrast to the 'heavy' gestures discussed above, TKV also uses lighter and more delicate gestures at times. For example, towards the beginning of the lesson, TKV sings the phrase '*ga-ma-ga',* performing the *svaras* in a relatively plain manner, although there is a small

gamaka up to *madhyama*, which coincides with the most emphatic hand motion in the phrase (see Media File 7.15). The smooth pitch movement here in which there are no oscillations or big leaps is reflected in the relatively smooth hand motion that accompanies it. It is also worth noting the 'pinch' handshape used here (see Figure 7.13), which, during an interview conducted while watching this lesson video, TKV suggested was suitable for accompanying long notes sung with a moderate to soft tone (TKV, Srirangam, August 16, 2014). The hand movement during this phrase can be defined using the Laban inspired action descriptor 'glide', in which effort is light in weight and sustained in time (see Table 7.3).

Figure 7.13: The 'pinch' handshape co-occurring with the phrase *ga-ma-ga* in TKV demonstration phrase 5 (Media File 7.15).

Aside from the relatively fast hand movement on *madhyama*, the lack of emphasis and smoothness of the gestures in this phrase show an iconic relationship with the lack of emphasis and smoothness in the melodic line (see Figure 7.14, Media File 7.15). In addition, the pinch handshape, which might typically be used to hold something delicate, acts metaphorically to suggest that the melodic phrase should also be treated with delicacy; the smallness of the imaginary object held in the pinch handshape indexes the smallness (softness) of the musical tone produced.

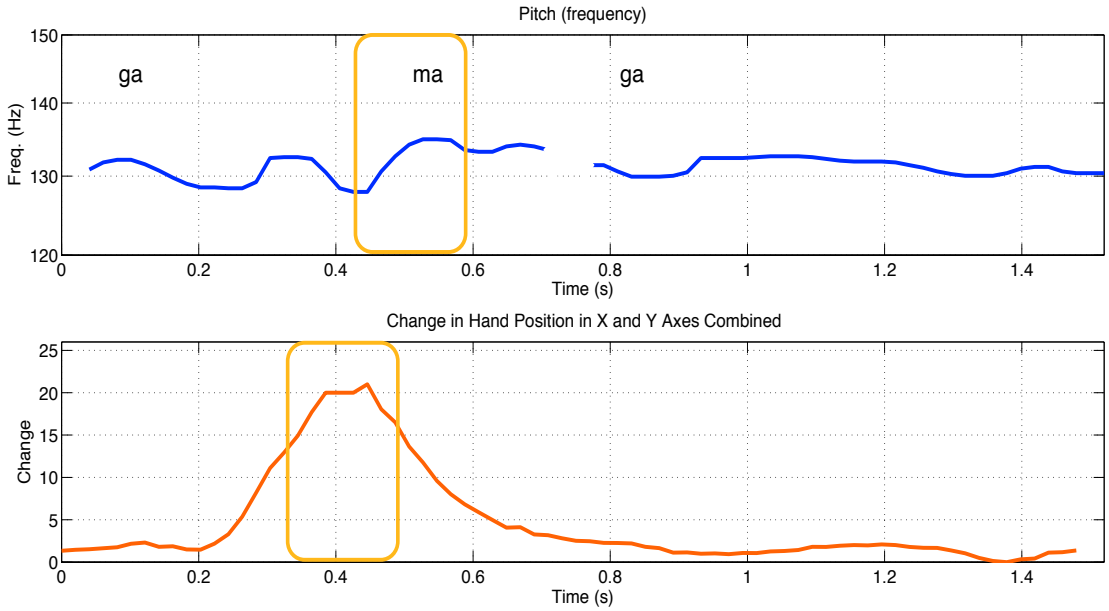

Figure 7.14: Pitch contour (blue line) and change in hand position (orange line) plots for part of TKV demonstration phrase 5 (Media File 7.15). The yellow boxes highlight the small *gamaka* up to *madhyama* and the sudden hand motion with which it co-occurs. The remainder of the phrase shows little pitch motion, and correspondingly little hand motion.

In summary to this section, analysis has shown that TKV frequently uses gestures that metaphorically imply weight and effort, both through handshapes employed, which are those that would be used to manipulate something heavy, and through the effort enacted in the gestures. Such gestures are not confined to TKV's hand movements. Effortful gestures often show themselves in the sympathetic movements of his upper body; for example, as he stoops under the effort involved in stretching an imaginary object (see Media File 7.1). Furthermore, in some phrases, TKV's head movements are also involved in indexing the quality of musical motion required (for example, Media File 7.13 from 0'36" to 0'54"). Analyses of trouble spots in which the student struggles to understand and imitate a phrase have shown that TKV's gestures work alongside other pedagogic tools to index the desired musical rendition, indexing qualities such as emphasis, duration, jerkiness/smoothness, and musical motion through a combination of iconic and metaphoric modes of gestural communication.

7.9.3 TS Sathyavathi and 'articulation'

Gestures produced by the vocalist T.S. Sathyavathi (hereafter TS) differ somewhat to those of TKV, with limited use of 'heavy' gestures, and a greater degree of correspondence between musical pitch and hand height in the vertical axis. Her student in the lesson analysed here is relatively advanced, and so tends to reproduce her teacher's phrases fairly accurately. However, on some occasions, details of attack, release, emphasis and musical motion are missing in her renditions, and it is on these musical qualities that TS often focuses her

corrections. Therefore, in the analysis that follows I will examine the way in which TS's gestures index such musical qualities.

(i) Articulation

[Media File 7.16]

On several occasions during my interviews with TS, she referred to the importance of conveying the correct 'articulation' (*uccāraṇa*) of *gamakas* and phrases to the student (see section 2.8 for a discussion of *uccāraṇa* in Indian music). While discussing the topic, TS made a connection between *uccāranna* and *bhāva* (mood), implying that without using the correct *uccāraṇa,* the proper *bhāva* of the phrase will not emerge. In TS's view, errors made in articulation lead to a performance that lacks *bhāva* (TS, Bangalore, August 17, 2013).

TS's concept of articulation can be illustrated by examining the way she employs the term during a lesson with her student Ashwini Satish (hereafter AS). At one point, she utters the word 'articulation' after correcting her student's rendition of an oscillation between two *svaras* (see Media File 7.16 at 0'15"). In this trouble spot, TS is unsatisfied with her student's first attempt to imitate the oscillation between *dhaivata* and *madhyama* in *rāga* Śahāna and so repeats that section of the phrase, this time with heightened vocal emphasis on *dhaivata*, and less on *madhyama* in order to make her point. In addition, she uses a gesture that differs from the one seen in the demonstration. Rather than simply moving her hand up and down as she did in the demonstration, she now rocks the hand back and forth, twisting from the wrist in a way that places greater emphasis on the upper than on the lower *svara* (see Figure 7.15 and Media File 7.17, showing TS correction phrase 9).

Figure 7.15: Rocking hand motion co-occurring with the oscillation between *dhaivata* and *madhyama* in TS correction phrase 9 (Media File 7.17).

This greater gestural emphasis is achieved largely through the faster speed of the hand movement at the point coinciding with the higher pitch in each oscillation (see Figure 7.16).

Here, TS uses emphatic (higher velocity) physical movements at the points of the phrase where musical emphasis should lie. In addition, the rocking hand movement illustrates subtle qualities regarding the quality of motion between one pitch and the next that would be difficult to verbalise. Following this demonstration, TS speaks a single word, 'articulation', clarifying that, for her, this correction of musical motion and emphasis is a correction of articulation (see Media File 7.16 from 0'11" to 0'15").

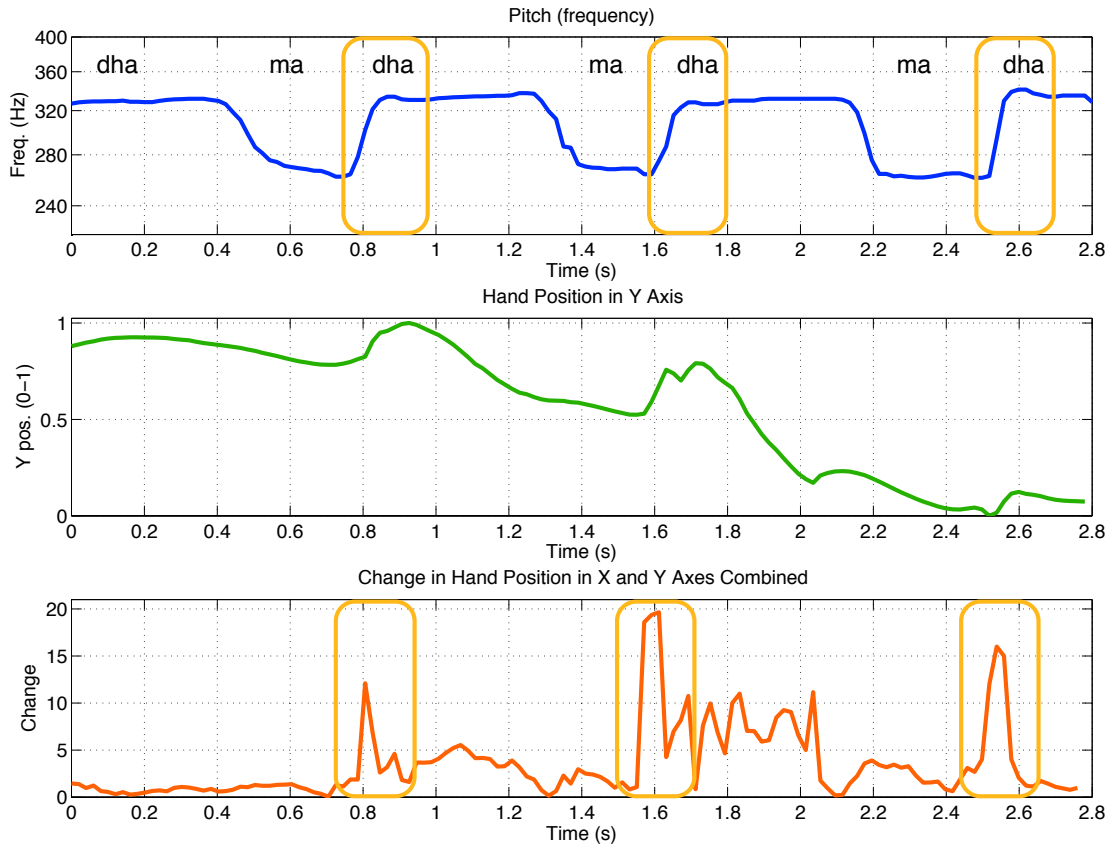

Figure 7.16: Pitch contour (blue line), y-axis hand position (green line), and change in hand position (orange line) plots for TS correction phrase 9 (Media File 7.17). The yellow boxes highlight the upward pitch movement to *dhaivata* and the corresponding peaks in hand speed in the lowest plot, demonstrating that the higher pitches are emphasised by the speed of the co-occurring hand movement.

Other subtle corrections of musical articulation will be considered in the following examples of gestures made by TS that index musical qualities such as emphasis, release, and musical motion.

(ii) Dab gestures and pulsation

[Media File 7.18]

In this example, TS demonstrates a phrase that consists of an oscillation between *madhyama* and *gāndhāra*, which gradually increases in speed before descending to *riṣabha*. In the initial demonstration phrase, this pitch oscillation is accompanied by a hand gesture that has a

‘pinch’ handshape and moves up and down in a dabbing motion that approximately corresponds with the oscillating pitch movement (see Media File 7.18 from 0’00” to 0’05”). TS’s initial objection to her student’s imitation regards incorrect pitch, which the student soon repairs, while TS’s second objection concerns the quality of musical motion in the student’s rendition of the oscillation. After the student tries two more times to imitate the quality required (Media File 7.18 from 0’11” to 0’17”), TS uses verbal correction to explain that the student is singing the phrase in a way that is too obvious. TS then demonstrates the phrase again, this time using a different gesture in which her she pinches and releases her fingers to correspond approximately with the oscillatory pitch movement (Media File 7.18 from 0’20” to 0’24”).

As mentioned previously, all three teachers use the pinch handshape widely in the lessons observed. It tends not to be used to accompany passages that might be considered ‘heavy’ or ‘forceful’, but co-occurs more frequently with detailed and subtle melodic movement. The physical basis of this mapping is that a pinch handshape would be used to hold something small or delicate, which maps to the singing of a musical phrase that might be considered ‘delicate’ due perhaps to its detailed pitch movements, relative softness, or subtlety of musical motion. The correction gesture used by TS from 0’20” to 0’24” in the trouble spot (Media File 7.18) emphasises the subtlety of the musical motion in this phrase by restricting physical movement to the touching and releasing of fingers: a far smaller physical motion than that normally used by TS while demonstrating and correcting phrases.

I discussed this trouble spot with TS during a follow-up interview in which we watched the video of the lesson. After observing the student’s failed attempts to imitate the phrase (Media File 7.18 from 0’11” to 0’17”), TS explained the situation as follows:

> See it is so dry; there is no *bhāva* in that. What she sings, it’s not with any emotion. No involvement. Not able to understand the feel of that *saṇgati*. I’m not happy. […] It has to throb; it has to pulsate. (TS, personal interview, Bangalore, August 11, 2014)

The last comment regarding the pulsating quality required was spoken by TS while observing her correction of the phrase, accompanied by the finger press and release gesture (Media File 7.18 from 0’20” to 0’24”). TS’s comments made while watching the video, clarify that she finds the motion qualities of throbbing and pulsation to be missing from her student’s rendition, and that without these qualities the phrase has no *bhāva*. The delicate, pulsating finger press gestures made by TS are analogous to the qualities of musical motion required in the phrase. Each press of the fingers here conforms to the action category of ‘press/dab’, consisting of Laban effort qualities that might be considered light to medium in weight and sudden in time (see Table 7.3). The press motions in TS’s gesture are approximately timed to

co-occur with the emphases on each oscillation, displaying an iconic relationship between finger pressure and vocal effort (muscular pressure), both of which are connected to sonic loudness. This relationship is most likely derived from bodily experiences of the relationship between physical pressure and loudness in sound, related to the previously discussed cross-domain mapping between increase in loudness and the application of external force (Eitan and Granot 2006; Eitan and Tubul 2010).

(iii) Object manipulators: dropping the tone

[Media Files 7.19 and 7.20]

Gestures produced by TS at the end of phrases often index qualities of the emphasis and release of the final pitches touched. For example, the second phrase in the lesson ends with a long *pañcama* and a very brief *madhyama*. Looking at TS's hand motion, the fastest movement occurs at the end of the phrase where she performs a gesture that moves rapidly back towards her body that coincides with the melodic movement from *pañcama* down to *madhyama* (see Figure 7.17 and Media File 7.19).

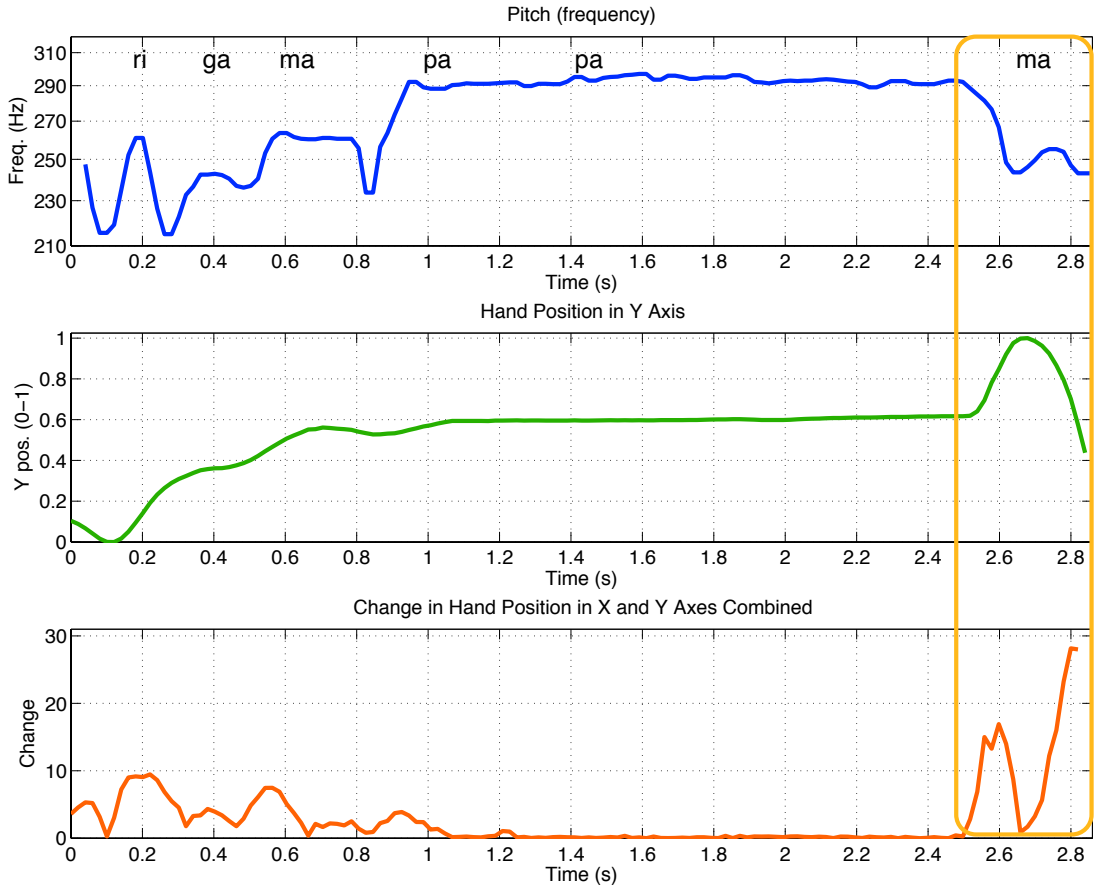

Figure 7.17: Pitch contour (blue line), y-axis hand position (green line), and change in hand position (orange line) plots for TS demonstration phrase 2 (Media File 7.19). The yellow box at the right of the figure highlights the sudden hand motion in the release gesture that co-occurs with the brief *madhyama* at the end of the phrase.

When asked about this gesture during an interview conducted later while watching the video, TS replied as follows:

> That means I have done it. I am done with it. […] So that just touching *ma*, is indicated by this. […] [she sings *pa-ma* at the end of the phrase] Dropping. Dropping that *pañcama* to *ma*. Because *ma* is very little. *Ma* is not elongated. That's it. (TS, personal interview, Bangalore, August 11, 2014)

TS's comments clarify that the gesture at the end of the phrase, consisting of a sudden jerk back towards her body as she releases her pinch handshape, expresses the brevity of *madhyama* at the end of the phrase. The duration of the gestural components map onto the duration of the *svaras*, with a held position on *pañcama* and a fast and brief movement co-occurring with the lightly touched *madhyama*. TS performs this type of release gesture at the end of many phrases in the lesson. For example, three minutes later into the lesson she sings the same phrase, and on this occasion the movement from *pañcama* to *madhyama* is accompanied by an even more emphatic hand motion back towards the body (see Media File 7.20).

Such release gestures can be regarded as object manipulators, as the pinch handshape is metaphorically holding the sustained *pañcama* and then releasing it on the movement to *madhyama*: a 'dropping' action, as described by TS. The releasing or dropping action indexes the fleeting and abrupt quality of *madhyama* in this phrase. In addition, the direction of the hand movement back towards the teacher's body is also significant. The space in which co-singing gestures occur begins a little away from the body and extends out as far as the singer can comfortably reach. Hand movements outside of this space, in particular those travelling back to the body or down to the lap tend to be used at the ends of phrases. Bräm and Boyes Braem (2001) mention similar gestures used by orchestral conductors, and describe them as 'taking out of view' gestures, in which 'what is being metaphorically taken away is all [of] the sound' (2001, p. 18).

The rapid hand movement back towards the body often used by TS at the end of phrases may also relate to the cross-domain mapping observed between direction of motion and increase or decrease in loudness. For example, Eitan and Granot (2006) found that increase in loudness is associated with a movement towards the listener, while diminuendo is associated with a movement away (2006, pp. 231-232). When the teacher sings in Karnatak vocal lessons, the student is the listener, and so to correspond with the cross-domain mapping observed in experiments by Eitan and Granot (2006) diminuendo should be mapped to movement away from the student. This is what occurs during TS's release gestures where

rapid movement back towards the body of the teacher maps to the sudden decrease in loudness at the end of the phrase.

(iv) Object manipulators: presenting and placing the tone

[Media Files 7.21 and 7.22]

The 'release' gesture discussed in the previous section is not the only action performed by TS that indexes the articulation of the final *svaras* in a phrase. Two additional examples will be discussed here: a 'presenting' gesture with an upward facing palm (Media File 7.21, showing TS demonstration phrase 94), and a downward 'placing' gesture (Media File 7.22, showing TS demonstration phrase 88). These two actions can be regarded as both metaphoric gestures and also as object manipulators, because they both appear to metaphorically hold the sound. In the first example, the gesture presents the sound to the listener (Media File 7.21) and in the second example, the gesture places the sound down at the end of the phrase (Media File 7.22 and Figure 7.18). The movement of the hand during both these actions indexes qualities of musical motion, duration and emphasis. For example, in the 'placement' gesture, there is a small jerk in the hand movement that coincides with an emphasis on the final *svara*, *niṣāda*, expressed here using a *gamaka* that slides from *ṣaḍja* to *dhaivata* (Media File 7.22 at 0'03"). In comparison, the 'presenting' gesture is performed with a smooth outward curving motion (Media File 7.21 at 0'03") that shows iconicity through motion and duration with the slight sustain followed by gentle release of the final *riṣabha* in the melodic line.

Figure 7.18: TS performing a 'placing' gesture at the end of demonstration phrase 88 (Media File 7.22). The sound is metaphorically held in her cupped hand, seen in the picture on the far left, which is then turned and placed down in a deliberate manner.

(v) Quality of motion: gliding gestures

[Media File 7.23]

So far in this analysis, we have seen that TS's gestures index musical qualities related to her concept of articulation, including emphasis, release, duration, and musical motion. The gestures performed by TS during the lesson are sometimes clearly object manipulators, such as the 'placing' and 'releasing' gestures discussed above, while on other occasions they are combinations of actions such as tracing, flicking, throwing, and gliding (see Table 7.3). Depending on how they are performed, some of these actions may also be regarded as object manipulators; for example, tracing and throwing gestures can be understood as tracing and throwing an imaginary object, which in this case is the melody. Other actions, such as gliding, involve no object manipulation, and can be understood instead as showing the path of an object, or portraying an object (or perhaps a bird) that is gliding. A particularly expressive gliding gesture can be seen seven minutes into the lesson in two consecutive demonstrations (Media File 7.23, showing TS demonstration phrases 56 and 57). Here, the teacher uses a two-fingered point gesture to trace the motion of the music making a rapid upward undulating motion in the first part of the phrase (*dha-ni-sa*), followed by a smooth gliding downward motion in the second part, mapping the pitch slide down from *ṣaḍja* to *pañcama* (see Figure 7.19).

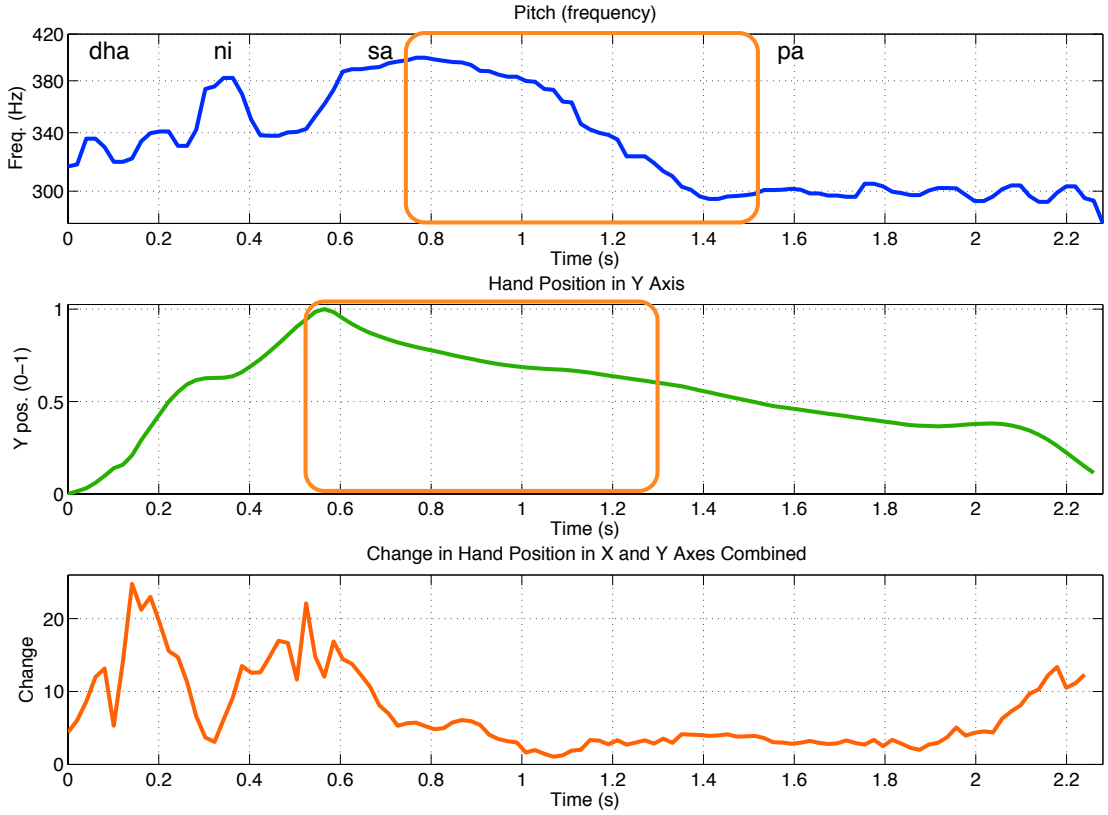

Figure 7.19: Pitch contour (blue line), y-axis hand position (green line), and change in hand position (orange line) plots for TS demonstration phrase 56 (Media File 7.23). The orange boxes highlight the downward pitch movement from *ṣaḍja* to *pañcama*, and corresponding downward hand movement. In addition the lower plot shows the rapid hand motion occurring during the initial upward pitch movement (*dha-ni-sa*), and the smoother and slower hand motion during the downward glide that follows.

The gliding hand motion in the second parts of each of these two demonstrations is iconic of the 'gliding' quality of musical motion performed: akin to that of a light object floating down to earth having been thrown into the air. In both the vocal rendition and corresponding hand motion there is a feeling of effort and energy in the upward figure that starts each phrase, and of ease and release during the downward gliding figure at the end of each phrase. In this interaction, the student imitates not only the musical motion of the phrases, but also, to some extent, the physical gestures of her teacher, and no corrections are necessary here.

In summary, the actions seen in TS's gestures range from those that are clearly object manipulators such as 'placing' or 'releasing' gestures, to those that seem more to map the path taken by an object or to portray an object, such as the 'gliding' and 'pulsating' gestures discussed. What all of these gestures have in common, however, is that they enact patterns of effort and motion that convey something of the musical rendition desired by the teacher. This is achieved through iconicity between physical motion and musical motion as well as through various connections supported by cross-domain mappings formed through accumulated physical experience, such as that between physical effort and sonic emphasis. By performing such gestures, TS emphasises the musical qualities required to render each phrase with *bhāva*.

7.9.4 Suguna Varadachari: tracing and flicks

Of the three teachers whose lessons are examined here, Suguna Varadachari (hereafter SV) produces gestures that show the closest relationship between pitch and hand position in the vertical axis (see chapter 6). Nevertheless, her gestures go beyond simply tracing pitch in space, and include actions that index other musical qualities such as duration, emphasis, and change in loudness and timbre. Like TS, SV frequently mentioned the importance of conveying *rāga bhāva* to students. She explained that a teacher's gestures can show '*bhāva*, nuances, and the style of the teacher', as well as helping students understand the *gamakas* and *anusvaras* in each phrase (SV, Chennai, August 18, 2014). In the following examples from a lesson in *rāga* Mukhāri given by SV to her student S. Hiranmayee, I will discuss tracing gestures and other gestural actions that are connected through metaphor and iconicity to musical qualities that contribute to *bhāva*.

(i) Tracing and pointing gestures

[Media File 7.24]

Towards the beginning of the lesson given by SV, there is an interesting shift in SV's gestural style in response to her student's first error (see Media File 7.24, showing SV trouble spot 1). During her initial demonstration phrase, SV employs a gestural style that could be described

as rhetorical, including gestures sometimes used during speech that intends to persuade or affect the listener (see Figure 7.20). However, after her student's failure to imitate the phrase with sufficient clarity, SV adopts quite a different gestural style, using a pinched and then pointed handshape to trace the pitch in space (see Figure 7.21).

Figure 7.20: Rhetorical gestures performed by SV while singing the initial demonstration phrase in trouble spot 1 (Media File 7.24 from 0'00" to 0'05").

Figure 7.21: Tracing and pointing gestures performed by SV while singing the subsequent correction phrase in trouble spot 1 (Media File 7.24 from 0'09" to 0'14").

Following this initial shift from rhetorical to tracing gestures the remaining phrases in the lesson are accompanied by a combination of tracing gestures and other actions, including flicks, dabs, and oscillations. An example of such a combination can be seen in the demonstration phrase that immediately follows trouble spot 1.

(ii) Combination of tracing and 'flick' gestures

[Media File 7.25]

SV traces much of the pitch movement in her second demonstration phrase using a pointing gesture, and a strong correspondence between pitch and hand position can be seen (see Figure 7.22). However, combined with this pitch tracing there are also 'flick' actions that index something of the fleeting and barely touched quality of melodic leaps with which they co-occur. In Figure 7.22, the two yellow boxes highlight a rapid oscillation involving an upward leap in pitch and a corresponding fast hand movement in the x-axis (Media File 7.25 from 0'04" to 0'05"), while the blue boxes highlight another pitch leap that co-occurs with a circular 'flick' gesture (Media File 7.25 at 0'06").

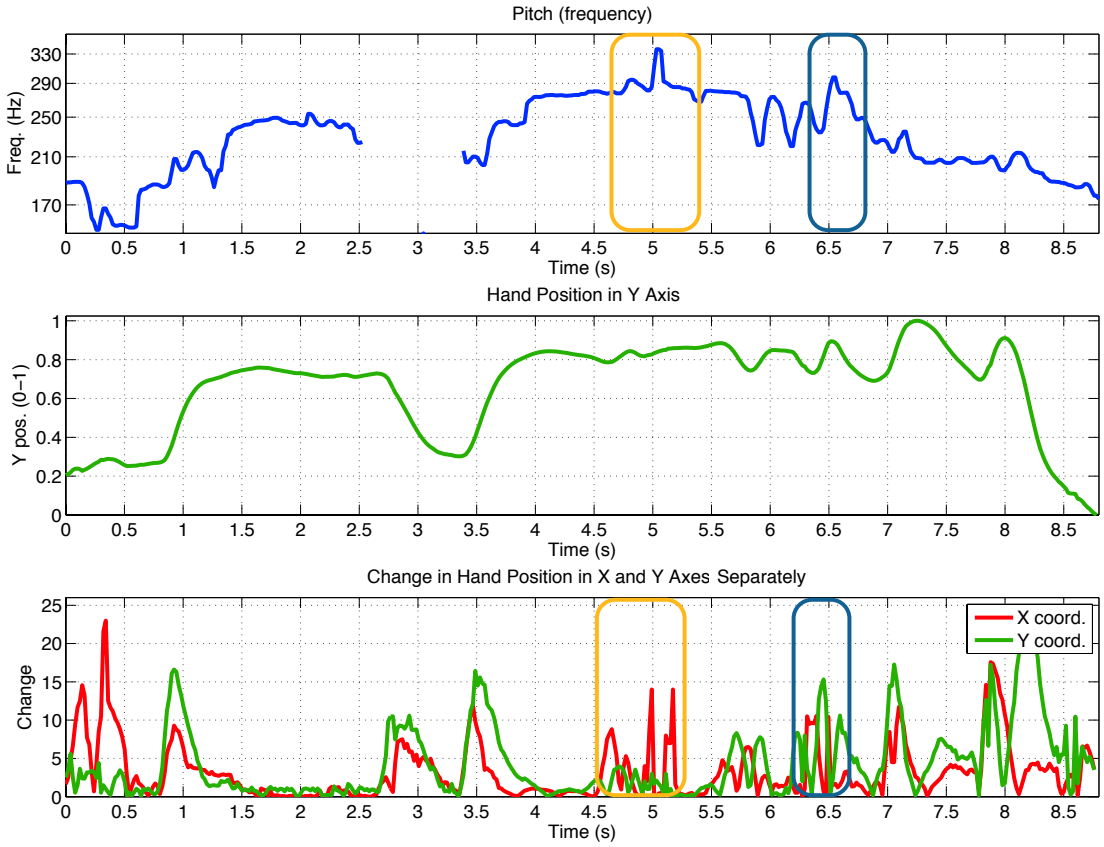

Figure 7.22: Pitch contour (blue line), y-axis hand position (green line), and change in hand position plots (lower green and red lines) for SV demonstration phrase 2 (Media File 7.25). The y-axis hand position shows a strong correlation with pitch for the phrase as a whole (r = 0.72). The yellow boxes highlight the rapid pitch oscillation that includes a pitch leap and the corresponding hand movement in the x-axis. The blue boxes highlight another leap upwards, which this time co-occurs with a circular 'flick' gesture, involving movement in both the x and y-axes as can be seen in the lower plot.

In both these highlighted areas, the speed of the gesture maps onto the speed of the melodic movement: the musical motifs at these points are either rapid oscillations or leaps to higher pitches that are touched only briefly. The circular 'flick' gesture (seen in Figure 7.22 and

Media File 7.25 between 0'06" and 0'07") is particularly characteristic of SV's gestural style, appearing frequently throughout the lesson and usually co-occurring with fleeting upward leaps in pitch. The musical qualities indexed by such flick gestures will be discussed further in the following example.

(iii) Flick gestures

[Media File 7.26]

In an example from later in the lesson, SV sings a phrase in which both of the two upward pitch leaps are indexed by 'flick' gestures, visible in the lower of the two plots of Figure 7.23 as peaks in speed of hand movement. Looking at the video recording (Media File 7.26, showing SV correction phrase 21) we can see that the first leap is indexed by a circular flick gesture (just before 0'01"), while the second leap corresponds with a flick back towards SV's body (just before 0'02"). Using Laban effort descriptors, the 'flick' action can be described as light to moderate in weight and sudden in time (see Table 7.3).

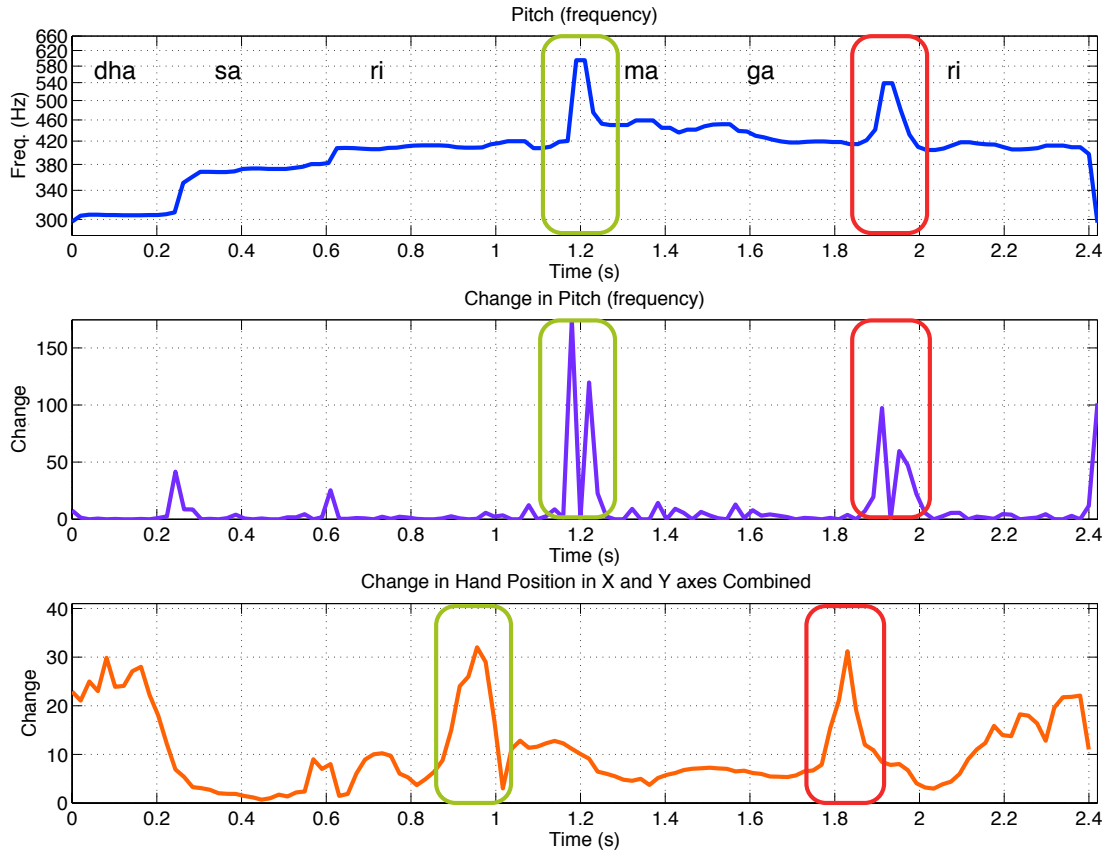

Figure 7.23: Pitch contour (blue line), change in pitch position (purple line), and change in hand position (orange line) plots for SV correction phrase 21 (Media File 7.26). The green and red boxes highlight the fleeting upward pitch leaps (to *anusvaras*), and the hand movements that index them.

The correspondence between the peaks in speed of the flick gestures and the peaks in speed of the pitch movement can be seen in the lower two plots of Figure 7.23, although the gestures precede pitch movement as is often the case in the gestures observed in all lessons (see section 6.5.7).

Beyond this correspondence, there is also a subtle relationship between hand motion and musical motion. The production of flick gestures can be described as involving a strong initial effort followed by relaxed and free motion in which the trajectory may be loosely guided rather than tightly controlled. I would suggest that there is often an analogous quality in both the musical and vocal motion indexed by such gestures. The pitches touched at the apex of the fleeting upward leaps discussed in this example are *anusvaras*, auxiliary pitches touched briefly in the course of *gamakas*. These would not be given *svara* names if the teacher were to sing the phrase using *sargam* (as indicated in Figure 7.23), although if a student struggles to understand a particular *gamaka*, the teacher will sometimes refer to an *anusvara* by the name of the *svara* that it is conventionally considered to touch. The upward leaps highlighted by the boxes in Figure 7.23 are both *anusvaras*. The first leap highlighted by the green box would conventionally be described as an *anusvara* up to *pañcama* during the *gamaka* joining *riṣabha* to *madhyama*, and the second leap highlighted by the red box would be described as an *anusvara* up to *madhyama* touched during the *gamaka* from *gāndhāra* to *riṣabha* (TKV, online interview, December 8, 2015). However, the actual pitches touched are somewhat higher than *pañcama* and *madhyama* respectively. In fact, the *anusvaras* are sounded so briefly that their actual pitch is unlikely to be perceived by the listener. Instead, they leave general sensory impressions that are considered pleasing in this particular context and are an important part of the traditional style (TKV, online interview, December 8, 2015). In such musical motifs, I would argue that the gestural quality conveyed is of equal important to the precise pitches touched. The 'flick' gestures produced by SV, which co-occur with fleeting leaps in pitch, map the initial impetus and subsequent loosely thrown quality of both the motion required to sing or play the motif, and also the musical motion expressed through the phrase.[41]

(iv) Flick gestures in a phrase with little tracing

[Media File 7.27]

In order to further illustrate the significance of flick gestures in SV's hand movements, I will briefly discuss another example in which such gestures index upward leaps in pitch that have a loosely thrown quality. In this example, there are very few tracing actions; in the first half

[41] See section 1.5.3 for a discussion of experiences of musical motion arising from the gestures of the performer.

of the phrase the only gesture seen is a circular flick, which indexes the *anusvara* at *pañcama* (Media File 7.27 at 0'01"). The second half of the phrase includes some tracing of pitch with a point gesture on the move down to *niṣāda* just before 0'04". This is followed by a gesture that flicks back towards SV's body, co-occurring with an upward leap onto an *anusvara* that touches just above *ṣaḍja* (Media File 7.27 at 0'04"). The two flick gestures can be seen as peaks in hand motion speed, highlighted by the yellow and red boxes in Figure 7.24.

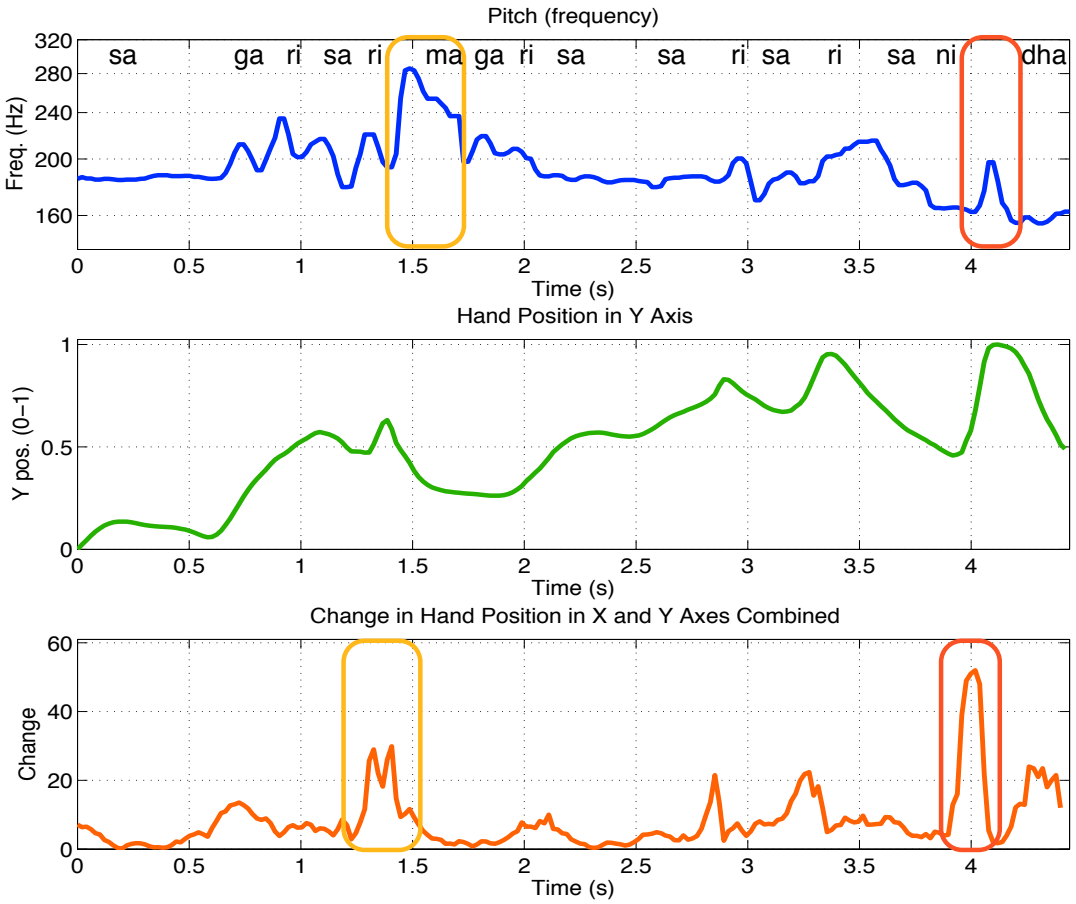

Figure 7.24: Pitch contour (blue line), hand position in y-axis (green line), and change in hand position (orange line) plots for SV demonstration phrase 3 (Media File 7.27). It can be seen that there is very little correspondence between the pitch contour plot and the hand position plot. The yellow and red boxes highlight the fleeting leaps up in pitch (*anusvaras*) and the relatively high speed of the hand movements that index them.

In both of the upward pitch leaps highlighted, the quality of musical motion is mapped by the quality of movement in the co-occurring hand gestures, showing an iconic relationship between the musical and gestural motion.

(v) Circle gesture

[Media File 7.28]

In addition to 'flick' gesture, SV uses several other gestural actions in this lesson, including 'dabs' and 'oscillations'. In one trouble spot, SV performs a series of circular gestures while singing repeated oscillating melodic motifs (Media File 7.28, showing SV trouble spot 14). In the initial demonstration phrase, SV alters the loudness and timbre of her voice during the oscillating musical figure that co-occurs with the lowest part of the gesture in the first cycle (Media File 7.28, from 0'01" to 0'02"). In her imitation, the student overdoes the change in mouth shape, leading SV to eventually criticise her for singing the syllable 'u' (Media File 7.28 at 0'19"). By the time she has reached the final correction in the trouble spot (Media File 7.28, from 0'22" to 0'26") SV has moderated her own change in timbre in the phrase, using less mouth closing in an attempt to rectify the student's exaggeration of the effect.

The circle hand gesture produced by SV in this trouble spot corresponds to the melodic shape of the phrase, with one circle corresponding to one repetition of the melodic figure. In addition it indexes something of the timbral shape of the repeated figure, with, in the first circle at least, the loudest and most 'open' timbre lying at the top of the circle, and the more 'closed' or muffled timbre at the bottom (Media File 7.28 from 0'00" to 0'02"). The hand motion also has an iconic relationship to the musical motion the teacher wishes the student to imitate. The gesture is superficially like the motion of a wheel; however, it does not move at a continuous rate: the hand motion is slower over the top of the circle and faster as it falls downwards and rises up again (see Media File 7.28 from 0'22" to 0'26"). As a result, the circular motion of the hand is akin to that of ball bearings running round a loop, gaining momentum on the way down, whipping round the bottom section, and losing momentum as they travel over the top. As can be seen in Figure 7.25, the rapid pitch motion during the two oscillations co-occurs with the fastest period of the hand motion in each case. Although it is a subtle point, I would suggest that the teacher is trying to convey a quality of motion and phrasing in her student's musical rendition that is analogous or iconic to the hand motion enacted. Such musical qualities of shaping and motion are the 'nuances' described by SV that bring the required *bhāva* to a performance (SV, Chennai August 18, 2014). The gestures made by SV highlight the qualities of shaping and motion in the musical phrases with which they co-occur, and thus can be considered one of the pedagogic tools she uses to convey such subtleties.

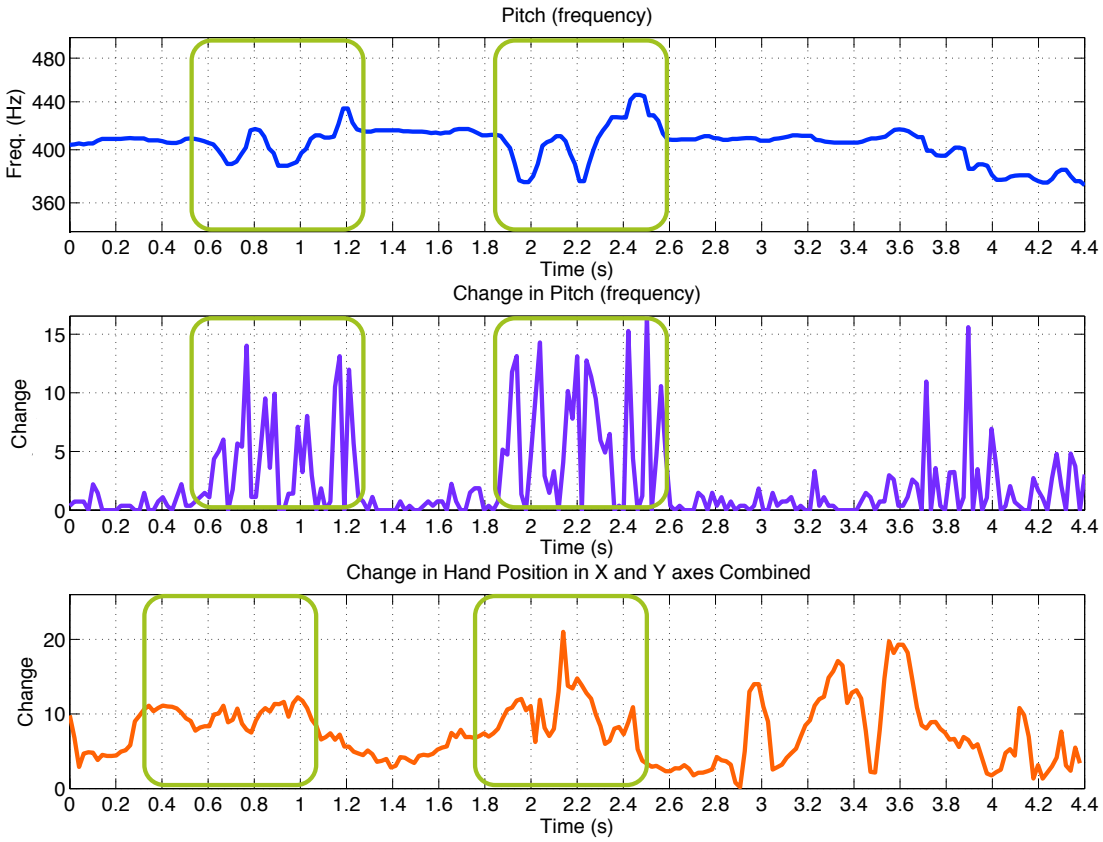

Figure 7.25: Pitch contour (blue line), change in pitch (purple line), and change in hand position (orange line) plots for SV correction phrase 26, which is the last correction in SV trouble spot 14 (Media File 7.28). Here the green boxes highlight the connection between periods of rapid change in pitch (seen in the middle plot) and periods of rapid hand motion (seen in the lower plot).

7.10 Summary and discussion

In the course of this analysis, I have drawn on interactions from three lessons to discuss ways in which Karnatak vocal teachers' gestures index a range of subtle musical qualities including emphasis, release, loudness, and timbre, as well as patterns of such qualities that can be experienced as 'musical motion'. Six gestural actions (stretch, hit, flick, dab, glide, and trace) commonly observed in the lessons have been listed alongside their Laban inspired descriptors in weight, time, and space (see Table 7.3). Examples of each action type have been presented and discussed in their pedagogic contexts. Each of the six actions listed in Table 7.3 was observed in at least two of the lessons analysed here. Action types tended to co-occur with similar musical qualities even when performed by different teachers, indicating that the actions have relatively stable musical referents; for example, TKV's use of the stretch action co-occurs with musical emphasis (Media File 7.5), while the same is true of a stretching gesture made by TS (Media File 7.29).

Notwithstanding the existence of shared action types, teachers also showed idiosyncratic gestural tendencies. For example, SV made little use of heavy actions such as

stretching and pulling, instead performing lighter pressing and dabbing gestures at points of musical emphasis. An example can be seen in the two-handed gesture in Media File 7.30, which could be described as a 'pull' or 'stretch' gesture, but is much lighter than those seen in TKV's lesson. Similarly, although all three teachers performed 'flick' gestures to some extent, they occurred most frequently in the lesson given by SV, where they appeared as idiosyncratic circular flick motions that co-occurred in particular with fleeting upward leaps (for example, Media File 7.27).

Differences observed in the type of gestures produced by the three teachers are likely due to a combination of factors including the character of the *rāga* being taught, the needs of the student, and the gestural habits of the teacher. It is likely that a *rāga* with many slow oscillating and sliding *gamakas* or strong musical emphases will lead the teacher to produce heavier and more emphatic gestures than *rāgas* with lighter musical motion. Regarding the needs of the student, if he or she shows an inability to reproduce emphatic musical motion, then clearly the teacher is likely to emphasise such motions during corrections. Finally, teachers appear to develop idiosyncratic gestural habits, with particular gestural forms reappearing across different lessons, sometimes linked to the same musical phrase. Examples of such connections persisting for several years or longer will be discussed in the following chapter.

The examples in the lessons analysed here included gestures from the three broad gestural types listed in Table 7.1. Object manipulators, were prominent in the lessons, including stretching (Media File 7.29), pulling (Media File 7.12), and throwing gestures (Media File 7.31). Examples of gestures enacting object motion were also given, including rebounds after stretching (Media File 7.1) or pulling (Media File 7.12), and uneven oscillating motions (Media File 7.28). Finally, gestures best described as self-generated motion without any object manipulation were also observed, including flicks (Media File 7.27) and tracing (Media File 7.25). Throughout the lessons, even in the absence of clear object manipulation actions such as stretching and pulling, handshapes tended to demonstrate a conceptualisation of music as an object by either holding or pointing to the sound in space. On various occasions, the music was grasped in a 'fist' handshape (Media File 7.1), pinched between fingers (opening section of Media File 7.19), or held in a cup handshape (Media File 7.22). Pointing gestures can also be regarded as treating music as an object: something that can be pointed to in space (for example, Media File 7.32). This tendency for music to be conceptualised as an object concurs with Lakoff and Johnson's description of metaphorical thinking, in which things without boundaries are conceived of as objects in order to clarify communication (1980, p. 25). By conceiving of music as an object, pointing to it at certain moments, grasping it with different handshapes, acting on it in different manners, it is

possible to convey information using gesture in a way that would be difficult without this first step.

Gestures observed in the lessons analysed tended to move rapidly and fluently between different types of action, agency, and handshape. Thus, tracing gestures were often punctuated by 'throw' or 'flick' actions. Similarly, 'object manipulators' frequently rapidly morphed into gestures that showed the motion of the object that had been manipulated; for example Media File 7.12 shows a pulling action that transforms fluently into a rebound, object-like motion. Throughout the lessons, the desired qualities of musical motion were indexed through detailed and expressive combinations of physical actions.

The gestures observed here are polysemous; however, as noted by Bräm and Boyes Braem (2001) of conducting gestures, this does not mean that one gesture can equally well be substituted for another (p. 16). There are mappings underlying the relationships found between gesture and music, which render particular gestures suitable for accompanying only certain musical features and qualities. Such mappings lie behind the tendency for similar gestural actions to co-occur with similar musical qualities. Mappings discussed in this chapter have been organised and summarised in Table 7.4. The details presented here are not meant to be exhaustive, but are merely those that appeared most clearly and frequently in the lessons analysed.

In the course of the analyses presented here, I have argued that in addition to indexing specific musical qualities, such as those listed in Table 7.4, teachers' gestures often map overall qualities of musical motion through iconicity between hand motion and musical motion. Ecological approaches to music perception have proposed that musical motion is perceptually real, and is conveyed through patterns of musical qualities such as emphasis, and change in loudness and timbre (see section 1.5 of this thesis; Clarke 2001; Shove and Repp 1995; Windsor 2011). Thus, the indexing of specific features identified in Table 7.4 contributes to mapping between gestural motion and musical motion.

Qualities of gesture	Corresponding musical qualities	Experiential basis of the mapping	Related verbal metaphors
Heaviness/force: implied through handshape (holding a large or heavy object), and physical effort Actions: stretch, pull, push, yank, hit, press	**Prominence**: emphasis, loudness, full timbre, sudden change in timbre or loudness, lengthened duration	• Bodily experience of heavy objects as perceptually prominent • Increased physical effort produces sonic emphasis	'give weight to the *svara*' 'stress *riṣabha*'
Lightness/delicacy: implied through handshape (holding a small object) and effort Actions: glide, flick, dab, trace	**Subtlety**: intricate details, quietness, lack of emphasis, relatively 'thin' timbre, fleeting	• Bodily experience of light objects as not perceptually prominent • Little physical effort produces soft sound that lacks emphasis	'touch *madhyama* lightly'
Duration and speed of hand movement	**Duration and speed** of melodic movement	Experiences of physical motion and the sound it produces	'move faster through the phrase'
Movement towards or away from the listener/student	**Dynamics**: crescendo mapped as moving towards the listener, diminuendo mapped as moving away	Experiences of sound emitted from a source being louder when the source is closer, and softer when the source is further away	'sing out'
Relative position of hand in vertical axis	**Relative pitch position** on a continuum from 'high' to 'low'	A combination of early physical experiences that connect high position with 'high' pitch	'high pitch, low pitch'
Quality of control in hand movement, for example the relatively uncontrolled trajectory in flick gestures	**Quality of control** in pitch movement, for example the flexibility allowed in pitch placement of some fleeting *anusvaras*	Bodily experience of controlled and free movement and of the sound produced by such movements	'throw that *svara*'

Table 7.4: A Summary of commonly found relationships between gesture and music, alongside the experiential bases of the mappings and metaphors with which they are associated.

I suggest that the spontaneous gestures produced by teachers in the lessons analysed here tend to enact the musical motion that the teachers wish to convey to their students. In some phrases, the motion expressed by the teacher is largely an interpretive choice; for example, SV's circular gesture in Media File 7.28 and TS's downward glide gesture in Media File 7.23. However, there are many motifs in Karnatak music that must be rendered with a specific gestural or motoric quality in order to be regarded as correct. This is related to the requirement in particular *rāgas* that certain *svarasthānas* should not be emphasised (see section 2.8). One example of a motif that must be performed with a particular pattern of

emphasis and de-emphasis, the movement from *riṣabha* to *ṣaḍja* in *rāga* Śaṅkarābharaṇam, has already been discussed in section 2.8 (Media File 7.9). Another example of a phrase that must be performed with particular gestural qualities appears in Media File 7.33 (*pa-dha-pa-dha, pa-ma-ga-ma*). Here, the two *dhaivatas* should be de-emphasised, as conveyed through the flick gestures, and the *madhyama* at the end of the phrase should be oscillated correctly in order for the phrase to be considered characteristic of the *rāga*. Similarly, the phrase sung by SV in Media File 7.26 must be performed with the gestural qualities indicated for it to be correct in *rāga* Mukhāri: the *anusvaras* should be fleeting and have a loosely thrown quality, as conveyed by her flicked hand motion. In each of these cases mentioned here, the *rāga's bhāva* will not emerge unless such gestural qualities are performed correctly. Thus in the Karnatak style, it is critical that students understand where to place emphases, de-emphases, and changes in loudness and timbre. In this chapter, I have shown ways in which gestures index such qualities, and have suggested the experiential and physical bases of the mappings that afford such indexing.

8 Catchments, Common Ground, and Addressee Gestures

8.1 Introduction

In the previous two chapters I examined connections between Karnatak vocal teachers' hand gestures and various musical features in order to better understand what is indexed, and, therefore, potentially conveyed, through gesture in vocal lessons. In this chapter, I will focus instead on interaction between teacher and student, looking at how their gestures contribute to the creation and maintenance of shared understanding. To this end, concepts from the wider field of communication and gesture studies will be employed for their ability to provide insight into interaction in the present context. The chapter opens with an overview of phenomena and concepts including 'addressee gestures', 'common ground', 'gestural convergence', and 'catchments' together with explanations of their relevance to Karnatak vocal lessons. Having laid this groundwork, the chapter will then progress to analyses of interactions in three vocal lessons in light of these concepts.

8.2 Addressee gestures, common ground, and gestural convergence

The majority of gestures arising in Karnatak vocal lessons are produced by the person who is singing or speaking. However, the listener also occasionally gestures. As teachers produce the majority of such gestures, I will initially focus on their perspective; however, gestures produced by students while listening to their teacher's rendition will also be examined later in this chapter.

As discussed in section 7.7, gestures produced by a Karnatak vocal teacher while listening to his or her student cannot be considered a form of conducting, as gesturing in this context lacks the formal framework that exists, for example, in orchestral conducting. Instead, I propose that such gestures have more in common with 'addressee gestures', identified in studies on gesture in classroom mathematics teaching (Alibali and Nathan 2012; Srisurichan et al. 2012). Addressee gestures have been defined as 'gestures produced by listeners (addressees) to correspond with other speakers' utterances' (Srisurichan et al. 2012), including, for example, teachers' indexing of students' speech using pointing gestures (Alibali and Nathan 2012, p. 257). Such gestures employed in pedagogic contexts differ from the nods and simple hand motions made by listeners during general conversation, termed 'gestural feedback' or non-verbal 'backchanneling', which are largely phatic, performing

general social functions such as conveying agreement or understanding (Allwood and Cerato 2003; White 1989). Although teachers' addressee gestures may include phatic elements, in addition they carry meaning relating to the idea being expressed by the speaker, and the communicative goal of the teacher. While purely phatic gestural feedback occurs frequently in daily conversation, addressee gestures as described here are rare in general conversational contexts. However, addressee gestures have been identified as occurring more frequently in pedagogic contexts where teachers tend to index students' speech with pointing and other gestures (Srisurichan et al. 2012).

It has been proposed that teachers' addressee gestures play a number of roles, including guiding student attention, clarifying referents, supporting students' understanding by making connections between instructional elements, and fostering common ground between teacher and student (Srisurichan et al. 2012). The term 'common ground' was used by Clark and Brennan (1991) to refer to the formation and maintenance of shared understanding, including 'mutual knowledge, mutual beliefs, and mutual assumptions' (p. 222). In any communicative situation much common ground is already in place; however, during interactions participants need to update common ground moment by moment, particularly in situations where coordination is required (Clark and Brennan 1991, p. 222). For example, in Karnatak vocal lessons, teacher and student already possess a large amount of mutual knowledge regarding the music being sung and the format of the lesson. However, as the lesson progresses, additional information must be shared; the student needs to be aware of where errors exist and how to overcome them, while the teacher needs to know whether the student has understood their corrections. Relevant to this latter point, Clark (1996) explains that during an interaction 'contributors need evidence that their respondents have understood what they meant, and the respondents try to provide that evidence' (p. 249). He terms such information from respondents, 'projected evidence', and notes that for it to be successful the information must be 'valid, economical, and timely' (1996, p. 249). Holler (2010) suggests that Clark's 'projected evidence' may also be provided through gesture (p. 14), a proposal that will be explored in the context of Karnatak vocal lessons in the analyses that follow later in this chapter.

While Clark and his collaborators (for example, Clark and Brennan 1991; Clark and Schaefer 1987) examined grounding processes mainly in language, other researchers have since explored the role played by gesture in such processes (for example, Nathan 2008; Nathan and Alibali 2011; Alibali et al. 2013; Holler 2010). Alibali et al. (2013) argue that gestures in mathematics lessons promote comprehension and learning by contributing to the establishment and maintenance of common ground. They suggest that gestures can assist in establishing common ground by 'delineating shared referents or connecting novel representations to more familiar ones' (p. 437). In the context of mathematics lessons, it has

been proposed that gestures act to ground both abstract concepts and teachers' instructional language by linking them with real-world, physical referents such as objects, actions, diagrams and other inscriptions (Alibali and Nathan 2007, p. 350). Such grounding can be achieved through addressee gestures in this context; for example, a teacher might clarify a student's meaning by pointing to relevant symbols on a board while the student speaks (Nathan 2008, p. 384). I suggest that it is fruitful to apply such concepts to gestural interaction in Karnatak vocal lessons. Although there are no boards or symbols for the teacher to point to in vocal lessons, we have seen in previous chapters that co-singing gestures themselves connect relatively abstract musical qualities to more concrete action and motion qualities through metaphor, iconicity, and mapping. Therefore, in the analyses that follow, I will explore ways in which both co-singing and addressee gestures contribute to the formation and maintenance of common ground between teacher and student.

Initial observation of vocal lessons suggests that addressee gesture may act as a particularly effective tool for the maintenance of common ground between teacher and student. During trouble spots in the lessons observed, teachers tend to make addressee gestures only at the point in the student's performance where the teacher anticipates or notices an error. Furthermore, such gestures often involve the production of the same gestural action employed when the teacher originally demonstrated the phrase. Students might only become aware of their errors when they find that the teacher is repeating a phrase, at which point they must discern where their error lies and how to remedy it. During trouble spots, an addressee gesture produced by the teacher while the student sings has the potential to guide the student's attention to the point at which the error lies. Furthermore, similarity in form between the teacher's addressee and co-singing gesture may act to forge connections between the teacher's way of singing the motif, the hand motion that expresses this (metaphorically or iconically), and the point of the phrase at which the student is required to produce the same qualities. The connections thus formed through gesture may, therefore, contribute to creating a shared knowledge of where increased clarity and care is required, and the nature of the rendition desired by the teacher at that particular point. The analyses presented in this chapter will explore this process in more detail.

Addressee gestures produced by students have somewhat different functions, due to the distinct roles of teacher and student in pedagogic scenarios. Nevertheless, students' addressee gestures may also contribute to common ground by informing the teacher as to whether or not the student has understood the location of the error and its solution. While simply singing the phrase correctly can demonstrate this to some extent, if the student gestures while the teacher is singing with an approximation of the teacher's own gesture, the teacher is left in no doubt that the issue has been understood. In this way, students' addressee gestures can facilitate the smooth running of the lesson. In the vocal lessons observed,

younger and less experienced students rarely produce addressee gestures, possibly because such students tend to gesture less overall. However, as we shall see in the analyses later in this chapter, more experienced students often perform addressee gestures that are similar in form to the teacher's immediately preceding gestures, thus contributing directly to the maintenance of gestural meaning and formation of common ground.

Here, the issue of unwitting gestural mimicry also arises, as students' addressee gestures sometimes converge with the form of the gesture produced by their teacher while singing the same motif. Such gestural convergence may also be seen in students' co-singing gestures, particularly in longer trouble spots where the teacher repeats the same gesture many times. Studies on co-speech gesture have explored the phenomenon of convergence in the form of gestures produced during verbal interactions, a phenomenon also referred to as gestural mimicry (Holler and Wilkin 2011a, 2011b; Kimbara 2006, 2008; Tabensky 2001; Wallbott 1995). Similar convergence effects have been found in language, where the phenomenon is known as 'structural priming' (Bock 1986), and has been characterised as resulting from implicit learning rather than from transient memory effects (Bock and Griffin 2000). Research seeking to isolate the cause of such mimicry in gesture has found that gestural convergence is greater when the speakers can see each other than when they only hear each other, suggesting that the convergence of gestural form does not arise purely from shared verbal meaning: seeing the gestures also plays a role (Kimbara 2008). Moreover, it appears that such gestural convergence is not a case of automated motor-mimicry, as studies have found that the mimicked gestures are not used randomly, but rather continue to be linked to the meanings with which they were originally presented (Mol et al. 2012; Holler and Wilkin 2011b).

Holler and Wilkin (2011b) interpret gestural mimicry during conversation as a confirmation of acceptance and understanding of the other speaker's meaning. In this way, gestural convergence can be viewed as contributing to the maintenance of common ground between speakers (Holler and Wilkin 2011b). In the analyses that follow I will consider how convergence of the student's gestures with those produced by the teacher might similarly contribute towards conveying the student's acceptance and understanding back to the teacher, thus updating the common ground between them. Before moving on to the analysis section, however, I will first discuss the phenomenon of 'catchments', another concept borrowed from the wider field of gesture studies, and relevant to the present context.

8.3 Catchments

In chapter 7 of this thesis, I discussed examples of interactions in which Karnatak vocal teachers repeatedly performed the same gestural action at the same point in a phrase,

sometimes both as an addressee gesture and as a co-singing gesture (see section 7.9). During such interactions the use of a repeated gesture to refer to the same musical quality or feature implies that the gesture, at least temporarily, has a stable referent. In the present chapter, I will chart the ways in which such gestures with stable referents emerge within trouble spots and across lessons. A useful concept here is the 'catchment', a feature originally defined by McNeill (2000) and since often referred to in the field of gesture studies. McNeill describes the phenomenon as follows:

> A catchment is recognized from a recurrence of gesture features over a stretch of discourse. It is a kind of thread of visuo-spatial imagery running through a discourse segment that provides a gesture based window into discourse cohesion. The logic of a catchment is that discourse themes produce gestures with recurring features; these recurrences give rise to the catchment. (2000, p. 316)

Thus, whenever two or more gestures with partially or fully recurring features are produced, the suggestion is that the same underlying theme or idea is being referred to in each case (2000, p. 316). Catchments can, therefore, provide insight into the meaning of gestures, as well as the manner in which such meaning is formed during pedagogic interactions. The notion of catchments is used by McNeill to support his theory that speech and gesture emerge from a common 'growth point' (McNeill 2000; McNeill and Duncan 2000), a concept that is related to Vygotsky's (1987) minimal psychological unit. The growth point theory is only one of many competing theories of gesture production, and is, therefore, not universally accepted amongst gesture researchers (for example, see Chu and Kita 2009; Hostetter and Alibali 2008). Nevertheless, the idea of 'catchments' as periods within discourses in which gesture forms reoccur in order to communicate the same meaning, can be useful whether or not one subscribes fully to the growth point theory.

McNeill (2000) presents examples of catchments identified through re-occurring gesture features performed by a speaker while describing the events from a cartoon. For example, when referring to a bowling ball the re-occurring gestural feature made by the speaker is a rounded handshape, and while describing the relationship between the bowling ball and the cartoon character the re-occurring feature is a gesture in which two hands lie in an analogous spatial configuration (p. 316).

The concept of catchments has not often been explored in research on music and gesture. The only substantial reference to the idea is presented by Rahaim (2012), who identifies a gestural form that re-occurs with a particular melodic feature in a performance of *rāga* Ramkali as a catchment. The gesture in question is a two-handed motion that curls around an empty spherical region in front of the singer's solar plexus, a movement that has an

analogous relationship to the melodic motion with which it co-occurs. Rahaim notes that in one performance the artist Girija Devi made this gesture in 30 out of the 34 occasions that the corresponding melodic feature was sung (p. 65). However, he observes that a performance of the same *rāga* by a different artist shows no similar gesture occurring with the same melodic feature. Rahaim also mentions a different gesture produced by another artist, which is repeated with the same motif across several performances (p. 65). Therefore, it appears that some North Indian vocalists develop idiosyncratic gestures that act as catchments across a performance, or sometimes across many performances.

Examples of catchments in Karnatak vocal lessons given by three different teachers will be examined in the analyses that follow. As will become apparent in this section, catchments are closely associated with both addressee gestures and the formation of common ground. In the analyses, I consider the role played by addressee gestures in the formation of catchments, and also explore how catchments contribute to the creation and maintenance of common ground between teacher and student. The main lessons analysed here are those explored in the three previous chapters. In addition, other lessons given by the same teachers will be discussed in order to examine the persistence of connections between gestural forms and musical features in lessons separated by months, or even years.

8.4 Analysis

8.4.1 Example 1: TKV

The lesson given by T.V. Ramanujacharlu (hereafter TKV) to his student, Sevia, in August 2013 presents numerous examples of addressee gestures and catchments. The trouble spot seen in Media File 8.1 shows TKV attempting to convey the correct performance of a rapid double oscillation on *riṣabha* in *rāga* Śaṅkarābharaṇam. The student struggles to imitate her teacher's performance, sometimes singing the oscillation too slowly, and sometimes omitting it entirely (see section 7.9.2, example iv). Throughout this trouble spot, TKV performs the oscillation on *riṣabha* together with a downward hit/yank gesture. This gesture occurs twelve times as a co-singing gesture, seven times as an addressee gesture, and also while TKV verbally explains that there should be more movement on *riṣabha* (Media File 8.1 from 0'27" to 0'30"). The downward hit actions performed by TKV as addressee gestures while the student sings are sometimes rather subtle (see Media File 8.1 at 0'09"), while at other times they are clear and very similar to the gesture used while singing; for example, there is a high degree of similarity between the co-singing gesture at 0'11" and the addressee gesture at 0'13", and also between the co-singing gesture at 0'49" and the addressee gesture at 0'53". I would suggest that the subtlety of some of the addressee gestures indicates that they do not

constitute a deliberate attempt to conduct the student, but instead, that they are a spontaneous expression of TKV's desire for the student to sing correctly.

Such spontaneity notwithstanding, TKV's repeated use of the hit/yank gesture together with the same musical motif, implies that the gesture has a musical meaning that is stable throughout the interaction. The interaction, therefore, provides a clear example of a catchment using the definition given by McNeill (2000), in which there should be two or more gestures with partially or fully recurring features (p. 316). The catchment in this trouble spot provides a 'gesture based window into discourse cohesion' (McNeill 2000, p. 316); the hit/yank gesture only co-occurs with the oscillation on *riṣabha*, which is, therefore, the discourse theme.

When the hit/yank action is performed by TKV as an addressee gesture, it provides a link between his own renditions of the *riṣabha*, where he also uses the gesture, and the point in the phrase at which he desires the same performance from his student. Thus, the addressee gestures in this interaction have the potential to create common ground, ensuring that the student understands both where the problem lies in the phrase as well as the nature of the rendition required. Rather than pointing at a whiteboard, as in the mathematics lessons analysed by Nathan (2008), the gestures in this context index meaning through iconicity with the musical motion required: the sudden down and up jolt of the hand referring to the same in pitch and quality of musical motion.

It can be seen that the student in this lesson uses very little hand or body gesture (Media File 8.1). As a fairly young and inexperienced student, she would not be expected to produce many gestures, and it can be seen from the few gestures she does produce, generally vague circles of the wrist, that her fluency in gesturing has not yet developed. Nevertheless, there are still interesting points to be made about her gestures in some of the examples that follow. In this particular trouble spot, however, she produces none of the sudden hit/yank gestures made by her teacher. As TKV works repeatedly to demonstrate the musical motion required, particularly in the latter part of the interaction (Media File 8.1 from 0'36" to 0'54"), the student does appear to pick up some of her teacher's head motion. However, this is so subtle that the slight change observed could easily arise from the change in the way she is performing the *gamaka*, rather than being an example of gestural convergence. Although TKV's physical gestures in this interaction index the musical motion required, on this occasion, the student provides little physical feedback.

As the phrase sung in this trouble spot does not appear elsewhere in the lesson, the persistence of the catchment across the lesson cannot be assessed. However, a similar downward hit gesture is used with a different phrase in the same lesson, co-occurring with another double pitch oscillation (Media File 8.2). In this case, the vocal oscillation is somewhat slower, and the co-occurring gesture is similarly less abrupt. The phrase in Media

File 8.2 (*sa-ri-sa-sa, dha-ni-sa*) is highly characteristic of *rāga* Śaṅkarābharaṇam, and so appears across numerous lessons. In a lesson given by TKV in 2013 to a different student, TKV does not perform the downward hit gesture with the phrase in question (see Media File 8.3). However, in a lesson given by TKV in 2011 the downward hit gesture can be observed (see Media File 8.4), and, indeed, the entire gesture here looks strikingly similar to that which co-occurs with the same phrase in the lesson with Sevia in 2013 (Media File 8.2). Therefore, it can be seen that connections between gesture and musical referent, in this case between a downward hit gesture and a rapid double oscillation motif, can persist, not only throughout trouble spots, but also across lessons many years apart.

8.4.2 Example 2: TKV

Another example of a catchment can be seen earlier in the lesson given by TKV to Sevia in a trouble spot previously discussed in chapter 7 (see section 7.9.2, example iii). Here TKV performs a yanking/pulling gesture on each of his corrections of the movement down from *gāndhāra* to *riṣabha* in the motif '*ga-ri-sa'* (see Media File 8.5 and Figure 8.1).

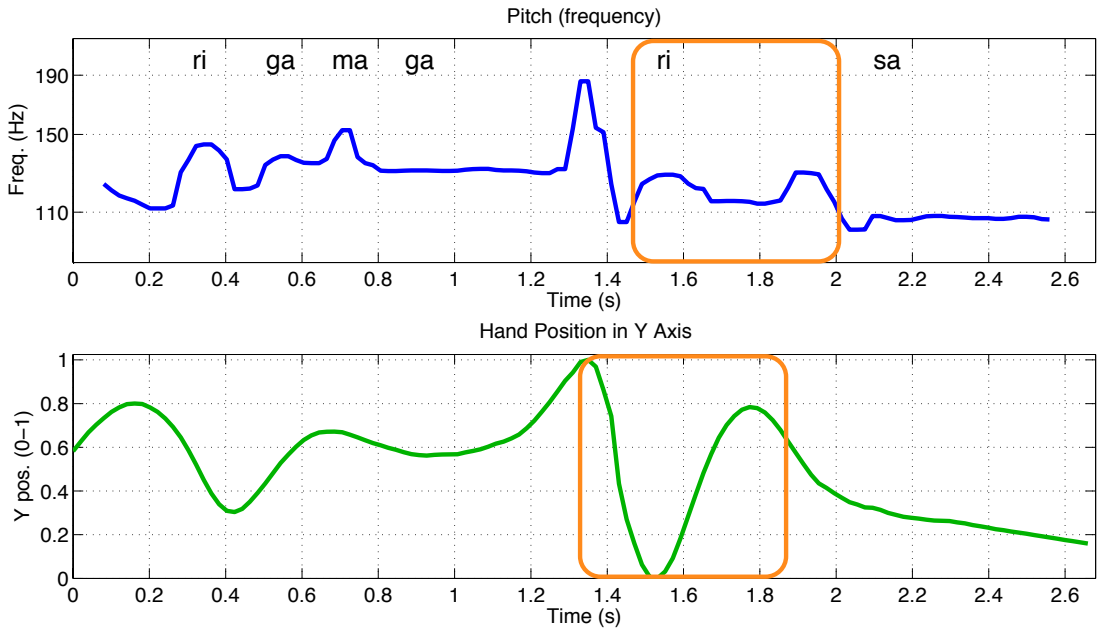

Figure 8.1: Pitch contour (blue line) and y-axis hand position (green line) for TKV correction phrase 11C within trouble spot 6 (Media File 8.5). The orange boxes highlight the sharp downward movement in pitch on *riṣabha* followed by the rebound movement up to *gāndhāra*, and the corresponding downward hand movement and rebound motion that indexes this pitch movement. The leap in pitch at the end of the long *gāndhāra*, and the leap up from *riṣabha* to *gāndhāra* near the end of the phrase are *anusvaras*: additional pitches forming the *gamaka-svara* units used to play the *svaras*. Figure also presented as Figure 7.10 in section 7.9.2.

While this phrase has already been discussed with reference to the metaphoric and iconic meaning of the yank/pull gesture (section 7.9.2, example iii), here I will consider the role played by addressee gestures during the interaction.

On the first performance of the *riṣabha* in question, TKV makes a forward and upward pushing motion (Media File 8.5 at 0'01"). During the student's imitation that follows, TKV performs a subtle addressee gesture while she sings the *riṣabha*, but the action seen in this case is a pulling gesture that moves out to the side (Media File 8.5 at 0'04"). However, while the forms of the addressee and original demonstration gestures differ, the point of emphasis and quality of motion is similar in both. Dissatisfied with the student's imitation in which she incorrectly dwells on the *gāndhāra* at the beginning of *riṣabha*, TKV performs the phrase three more times in a row in an attempt to correct her error. In each of these renditions TKV performs a pulling or yanking gesture that moves out to the side (see Media File 8.5 from 0'05" to 0'13), similar to the addressee gesture that preceded the sequence (Media File 8.5 at 0'04"). Finally TKV makes the same pulling gesture again as an addressee gesture during the student's final and correct imitation attempt (Media File 8.5 at 0'14").

During this interaction, the 'discourse theme' (McNeill 2000, p. 316) of the catchment could be defined as the melodic motion on *riṣabha*, in which *gāndhāra* should be touched strongly but briefly as an *anusvara*, before immediately descending to *riṣabha*. The melodic motion here can be thought of as a 'pull' off of *gāndhāra* and on to *riṣabha*, and this metaphoric musical pull is iconically expressed through the pulling actions that appear in the two addressee gestures, as well as the sequence of three corrections that lie between them. The addressee gestures consist of only this pull action that co-occurs with *riṣabha*, indicating that this is the most significant element in the trouble spot and helping to identify it as the discourse theme. By performing such addressee gestures, in which only the solution to the error is indexed, TKV creates a shared understanding with the student of where the error lies, and what can be done to correct it. He creates common ground through the addressee gesture, the meaning of which is supported by the gesture's similarity to his co-singing gestures performed at the same point in the phrase.

The student's gestures in response are typically understated; she produces no addressee gestures, and her co-singing gestures during both imitation attempts consist only of three small circular hand motions made near the floor. However, it is interesting to note differences in the timing and quality of the last of the three circular hand motions on each of her attempts. On her first and incorrect rendition of the phrase, the final circular gesture appears split into two sections with a preparation movement on the *anusvara* on *gāndhāra*, and another small jerk on the *riṣabha*, that follows (see Media File 8.5 at 0'04"). Meanwhile, in her final and correct imitation the gesture is more definite, with a single clear flick starting on *gāndhāra* (Media File 8.5 at 0'14"), matching the timing of TKV's 'pull' hand gesture.

Although this shift in gesture is slight, it may reflect the change in her understanding of the phrase, as well as perhaps some influence from the motion quality and placing of TKV's co-singing and addressee gestures.

This phrase is sung on one other occasion in the same lesson, occurring one minute before the interaction already discussed. On this occasion TKV uses a two part push-pull gesture while he sings the phrase, and then a pull action for the addressee gesture that follows (Media File 8.6): a similar combination of gestures to those seen at the opening of the trouble spot already discussed here (see Media File 8.5 from 0'00" to 0'05"). In the earlier attempt to teach the phrase (Media File 8.6) the student also sings the phrase incorrectly, but on this occasion TKV does not attempt to fix the problem.[42] The student's co-singing gesture during this first incorrect attempt to sing the phrase also displays evidence of her misunderstanding of the movement on *riṣabha*, splitting it into two small circles (Media File 8.6 at 0'04"), rather than showing it with a single stroke as she does when performing it correctly later in the lesson (Media File 8.5 at 0'14").

In a lesson given two years earlier, TKV accompanied the same phrase with a 'pull' action, both in his co-singing and addressee gestures (see Media File 8.7). The gestures here are very similar to those performed in the lesson that took place in 2013 (see Media File 8.5 from 0'10" to 0'15"). Once again, this demonstrates that connections between specific gestural actions and musical motifs may persist across lessons separated by several years. Such connections notwithstanding, the gestures are not symbols that are always be used with a given phrase. Some variation in the routinely connected gestures/motif pairings may occur even within lessons; for example, the shift already discussed between the pushing gesture in the opening demonstration and the pulling gesture in the corrections that follow in the lesson given in 2013 (Media File 8.5). Nevertheless, the point at which gestural emphasis is placed, the pull or push on the *anusvara* on *gāndhāra*, is the same in all of the teacher's renditions of this phrase observed in the two lessons in 2013 and 2011. So it can be seen that while form persists to some extent, it is the quality of gestural motion, heaviness and suddenness in this case, that is more resiliently linked to a motif.

8.4.3 Example 3: TKV

A different trouble spot from TKV's lessons given to Sevia in 2013 provides an example of an interaction during which a catchment is developed through the need to communicate a particular musical feature. Here, TKV sings a phrase that includes two leaps up to *svaras* theoretically identified as *dhaivata*, but which are characteristically sung at a pitch somewhat

[42] It is common for teachers to ignore some student errors when teaching relatively inexperienced students, so as not to overwhelm them with corrections.

higher (see Figure 8.2). The student fails on her first attempt (Media File 8.8 from 0'03" to 0'06") and so TKV sings the phrase again, but this time with *sargam* (0'06" to 0'09"). The student then hesitantly begins another attempt, but noting her uncertainty TKV interrupts to give another demonstration with *sargam*, this time sung more slowly (0'10" to 0'13"), after which the student manages to imitate the phrase fairly well with *sargam*.

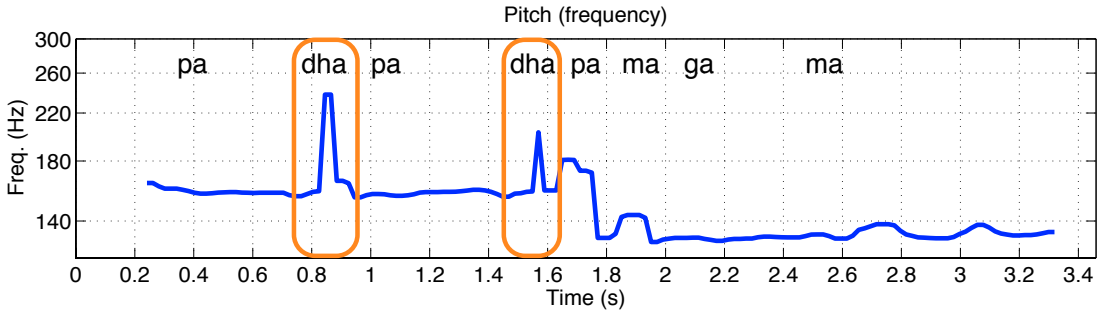

Figure 8.2: Plot showing the pitch contour in TKV correction phrase 23 (Media File 8.9) sung during trouble spot 9. The orange boxes highlight the two leaps up to *dhaivata*. TKV sings *sargam* in this phrase, confirming that the conceptual pitch here is indeed *dhaivata*, but the pitches actually touched are higher.

Looking at the gestures of TKV and his student during this interaction we can see a gradual development in their form. In the original demonstration, TKV's gestures simply chunk the phrase into four sections using four broad sweeps that move largely in the vertical axis (Media File 8.8 from 0'03" to 0'06"). However, noting the student's inability to grasp the phrase, TKV produces gestures during his following corrections that map specific musical features, in particular the upward leaps to *dhaivata*. In the first correction, only the first leap is indexed with a pull gesture that loops upwards (0'06" to 0'09"), while in his second correction both leaps to *dhaivata*, are indexed with such gestures (0'10" to 0'13"). These gestures indexing the pitch leaps can be seen in Figure 8.3 as peaks in change in hand position, an indication of speed.

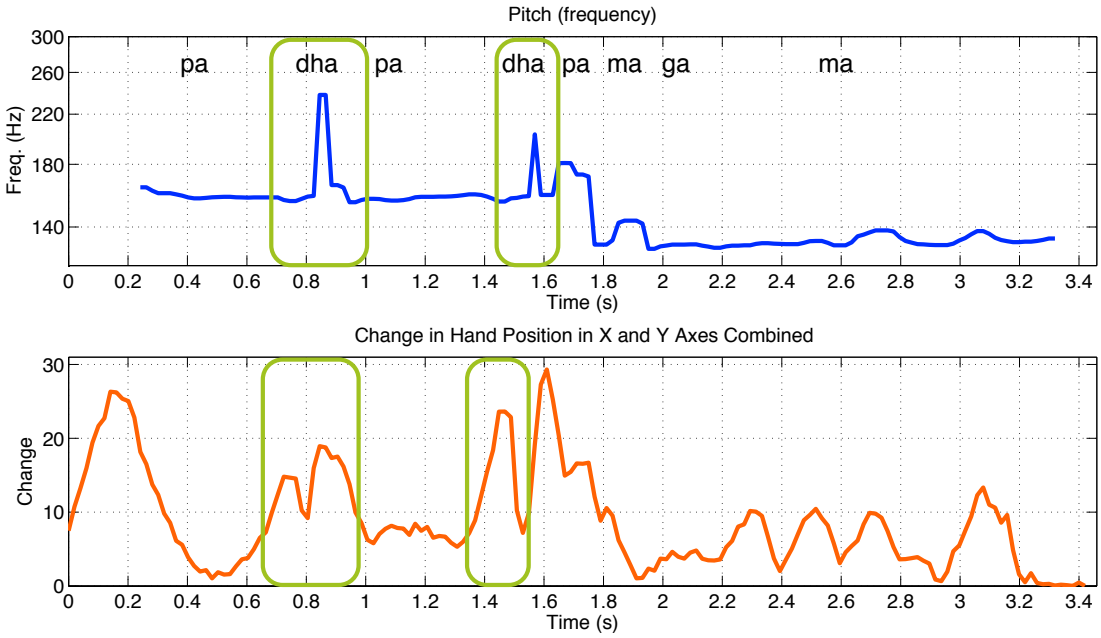

Figure 8.3: Plot showing the pitch contour (blue line) and change in hand position (orange line) in TKV correction phrase 23 (Media File 8.9) sung during trouble spot 9. The green boxes highlight two peaks in change in hand position (an indication of speed) that co-occur with the two *dhaivatas*. As is typically the case, the onset of the hand motion begins slightly before that of the pitch movement.

Following TKV's second correction in this trouble spot, the student succeeds in singing the phrase correctly with *sargam*. TKV then repeats the phrase without *sargam* two more times to ensure that she has understood completely, using the same pull/loop gesture for each *dhaivata* (Media File 8.8 from 0'16" to 0'31"). The interaction as a whole, therefore, appears to be a catchment in which one of the discourse themes is the repeated leap up to *dhaivata*. This is, however, not the only discourse theme in the trouble spot, as TKV repeatedly uses a circular oscillating gesture to indicate the oscillation on *madhyama* at the end of the phrase, and also a sharp pull gesture out to the side to convey the quality of the motif comprising the *svaras pa-ma-ga* (coinciding with the highest peak in change in hand position in Figure 8.3). Fragments of these repeated co-singing gestures also appear as addressee gestures made by TKV; for example, a jerk of the head that co-occurs with the second *dhaivata* at 0'15", and a pull gesture on the motif *pa-ma-ga* at 0'21". However, addressee gestures play a somewhat lesser role in this trouble spot than in the previous interactions discussed.

A notable feature of this trouble spot is a shift seen in the student's gestures between her first incorrect attempt and her later correct imitation of the phrase with *sargam*. During her first attempt to sing the phrase, her gestures consist of tiny vague circular motions that largely fail to synchronise with the principal melodic features (Media File 8.8 from 0'03" to 0'06"). However, during her correct imitation of the phrase with *sargam*, the student's gestures show clear jerks that co-occur with the leaps up to *dhaivata* (Media File 8.8 from 0'14" to 0'17"). As in the previous trouble spot discussed in this chapter, the student's

gestures become more like those of the teacher when she sings correctly; however, this similarity lies not in the form of the gestures, but rather in their points of emphasis and quality of motion. It is unclear, whether these changes occur due to her improved understanding of the phrase or as a result of gestural convergence arising from observation of her teacher's gestures. In either case, the convergence of her gestures (in emphasis and motion quality) with those of her teacher may communicate to TKV that she has accepted and understood his correction, acting as a form of 'projected evidence' (Clark 1996, p. 249) and thus contributing to common ground.

TKV's lesson with Sevia is particularly rich in addressee gestures and catchments. The student's relative lack of experience compared to the other students in lessons analysed here, together with TKV's willingness to repeatedly correct her errors means that trouble spots in this lesson are rather extended, presenting more opportunities for catchments to develop. Nevertheless, the lessons given by Suguna Varadachari (hereafter SV) and T.S. Sathyavathi (hereafter TS) also provide many examples of addressee gestures and catchments, notwithstanding the greater experience of their students and the tendency for trouble spots to be shorter.

8.4.4 Example 4: SV

The example discussed here is a brief trouble spot from the lesson given by SV in which both a catchment and an addressee gesture can be seen (Media File 8.10). Towards the beginning of the initial demonstration phrase, SV sings a motif in which the pitch remains briefly on *riṣabha* before flicking up to *madhyama* and then descending down through *riṣabha* to *ṣaḍja* (*ri-ma-ga-ri-sa*) (see Media File 8.10 from 0'00" to 0'01"). In the gesture that accompanies the phrase *ri-ma-ga-ri,* SV's hand remains briefly remains motionless on *riṣabha* before flicking up and over, forming a trajectory that is analogous to the pitch movement here and also conveying something of the quality of musical motion required (0'00" to 0'01"). During the student's imitation of the phrase, SV performs an addressee gesture that consists only of the flick-over action (0'05" to 0'06"), which co-occurs with the same point in the motif as in her original demonstration. Unsatisfied with the student's imitation SV then repeats the phrase, this time holding *riṣabha* a little longer and gesturing in a slightly more emphatic manner that highlights the brief holding of *riṣabha*, before flicking up onto *madhyama* (0'06" to 0'07"). It appears that SV perceives a lack of clarity in the student's performance and so attempts to correct it by slightly exaggerating the length of the initial *riṣabha*. The student makes only a very marginal adjustment, and SV does not seem entirely happy with the rendition. However, she moves on to sing a new phrase nevertheless. Although this trouble spot is brief, a gestural catchment can be seen in SV's repeated use of the flick-over action

that co-occurs with the same melodic feature in both of her co-singing gestures as well as in the addressee gesture.

In this interaction, the student's gestures are notable for their similarity to those produced by SV. The student rests her arm on her thigh and thereby restricts her movement to small motions from the wrist performed low towards the floor. Notwithstanding this restriction, both of her co-singing gestures display a similar flick-over motion to that produced by the teacher. Furthermore, the student even appears to be producing subtle addressee gestures of her own, performing a restrained half loop motion with her fingers while her teacher sings the motif in question (see Media File 8.10 at 0'07"). The student is clearly focused on the discourse theme of the catchment, and her addressee gestures seem to arise out of this focus, as though she is testing her understanding of the phrase before singing it. The gestural convergence seen in the student's gestures here may also provide 'projected evidence' (Clark 1996) of her acceptance and understanding to her teacher, thus maintaining common ground.

8.4.5 Example 5: SV

Another brief trouble spot later in the lesson given by SV also combines a number of addressee gestures and evidence of gestural convergence (Media File 8.11). Here SV sings a series of ascending, looping melodic figures, accompanied by hand gestures that perform a string of ascending undulations (Media File 8.11 from 0'00" to 0'01"). The student makes a similar series of loops with her fingers as she imitates the first part of the phrase, while her teacher simultaneously performs addressee gestures with a comparable looping form (0'04" to 0'05"). In the correction that follows, the teacher once again performs the same gestures with the ascending phrases, while the student produces a similar but subtler looping addressee gesture (0'07" to 0'09"). On this occasion, the looping gestures do not appear to index the point of the phrase in which there is an error; the mistake made by the student lies more towards the end of the phrase. The interaction does not have a clear single discourse theme, but rather contains several prominent features. The upward string of looping gestures are highlighted by teacher and student, who perform them as both addressee and co-singing gestures. Such gestural emphases may assist in conveying and keeping track of the number and placement of motifs, as well as the unfolding quality of musical motion in a phrase that is relatively complex.

8.4.6 Example 6: SV

A more sparing use of addressee gesture made by SV can be found earlier in the lesson where she employs gesture along with other pedagogic tools to indicate to her student that a *svara* should be performed with a shaking *gamaka*. In this case the interaction starts with a phrase suggested by the student (Media File 8.12 from 0'01" to 0'04"). SV interrupts, speaking in English, saying '*ma*, little bit…' before correcting the student's rendition of *madhyama*, which in this phrase should be sung with a narrow and rapidly oscillating *gamaka*. SV's correction at this point is accompanied by a hand gesture in which her fingers are pinched together and a barely discernable shaking motion is made, which can also be seen in her head movement (Media File 8.12 from 0'06" to 0'08"). In her subsequent imitation, the student mimics both the vocal oscillation and pinched handshape, although without any shaking motion in the hand (0'11" to 0'13"). However, SV is still dissatisfied with her student's performance and so interrupts and repeats the correction, this time with a clearer shaking hand and head motion (0'13" to 0'15"). An exaggerated version of this shaking hand gesture is then produced by SV as an addressee gesture during the student's final attempt at the phrase (0'17" to 0'18"). SV ends her addressee gesture and nods in approval when it becomes apparent that the student is now singing the *gamaka* correctly.

In this trouble-spot, once again, the discourse theme of the catchment is clear from the teacher's repeated use of the same gestural form to refer to a particular musical feature throughout the interaction: the pinched and slightly shaking hand gesture referring to the narrow oscillation on *madhyama*. The teacher's exaggerated addressee gesture from 0'17" to 0'18" into the trouble spot pre-empts the possibility that the student will fail to render the *svara* with enough shake, which however does not transpire, and so the addressee gesture is cut short. The student's co-singing gestures change after the teacher's first correction to become more like those of her teacher, taking on the same pinch handshape. This handshape might convey a sense of precision, as it is a handshape that would be used to manipulate something small: an action that is likely to require precision. The change in the student's gesture to become more like that of her teacher seems, in this case, to be an instance of gestural convergence, because of the clear change in her handshape from cupped in her initial phrase to pinched in her later imitation. However, the possibility of the gesture altering due to her changed conception of the phrase cannot be ruled out.

8.4.7 Example 7: TS

Of the three students whose lessons are discussed here, the student taught by TS displays the most confident use of gesture. Like the other students, she starts the lesson with her arm resting on her leg, and gestures with small wrist movements. However, as the lesson

progresses she lifts her arm from her knee and moves quite freely. Like SV's student, TS's student frequently shows gestural convergence with her teacher's movements. In such cases, the gestures may not be reproduced in their entire form, but instead show similarity in quality of motion and points of emphasis. An example can be seen fairly early in the lesson at around the point where the student first starts to lift her hand from her knee.

In this example, TS demonstrates a phrase consisting of a series of motifs somewhat like turns in Western art music, making straight pressing gestures on each turn (Media File 8.13 from 0'00" to 0'03"). TS interrupts her student's first attempt to sing the phrase, and repeats one of the motifs again, but this time with a curved swooping gesture rather than the straight pressing gesture used in her initial demonstration (at 0'06"). Immediately after this brief correction she says the word 'link'. Judging from this verbal instruction and differences between her performance and that of her student, she wants her student to move faster and more smoothly through the each motif, to ensure that each motif is linked to the next. TS's new curved swooping gesture conveys something of both the speed, smoothness, and linking quality required. She later uses the same action in an addressee gesture while her student attempts the phrase again (0'08" to 0'10"), but is still dissatisfied with her student's rendition. TS, therefore, sings the end of the phrase along with the curved swooping gesture once more (0'10" to 0'12"), and appears satisfied with the subsequent rendition produced by her student.

The swooping gesture produced by TS in response to her student's error reappears throughout the remainder of the interaction along with the motifs in question, producing a clear catchment. The underlying discourse theme here could be described as the quality of musical motion desired during and between the turn-like motifs. The swooping actions occur also as addressee gestures, guiding the student towards the correct rendition, and in response, the student's gestures gradually converge with those of her teacher. In her first attempt at the phrase, the student's hand remains on her knee and moves very little. However, after TS's first correction the student lifts her hand from her knee and makes some tentative gestures, the last of which has a curved quality (Media File 8.13 from 0'08" to 0'10"). The student makes no addressee gesture with her hand during the second correction from her teacher, but does dip and raise her head in synchronisation with the last of her teacher's swooping hand gestures (0'11" to 0'12"). Subsequently, gestures produced by the student in her last attempt become noticeably more like the swooping gestures produced by her teacher (0'13" to 0'15").

The student's gestures in her last rendition of the phrase converge with the aspect of the teacher's gestural motion that is most salient to the discourse theme here: the linking quality. In this way, the student conveys to the teacher that her correction has been understood and accepted, thus providing 'projected evidence' (Clark 1996) and updating common ground between student and teacher. In addition, by mimicking the salient aspect of the teacher's gestures, first with her head motion in the addressee gesture at 0'11" to 0'12",

and then with her hand at 0'13" to 0'15", the student directly experiences the physical motion that has been linked to the phrase through her teacher's gestures. As the teacher's gestures convey the quality of musical motion required in the phrase, it is possible that the student could gain insight into this motion through such gestural convergence.

8.4.8 Example 8: TS

On several occasions during the lesson, the student's upper body movements show gestural convergence with the teacher's own physical motion. For example, in one interaction TS sings a descending phrase that is accompanied by a series of pushing gestures, expressing the qualities of emphasis and release required on each motif (Media File 8.14). It is evident here that on each of TS's push gestures the student responds with an equivalent backwards motion in her head and upper body. The student's body movements have a similar quality of motion and rhythm to the hand gestures produced by the teacher, although they differ in their form and are performed by different parts of the body. As in the previous example (8.4.7), in addition to signalling to her teacher that she has understood the musical motion required, this gestural convergence may also help the student reproduce the phrase through direct physical experience of the relevant quality of motion: the patterns of emphasis and release required to sing the phrase with *bhāva*.

8.4.9 Example 9: TS

On other occasions in this lesson, the student's gestural convergence appears less connected to qualities of musical motion such as emphasis and release, and more linked to the tracking of melodic patterns. An example of this can be seen in a brief interaction earlier in the lesson (Media File 8.15). The gestural convergence here can be seen first in an addressee gesture made by the student while TS sings the phrase for the second time (Media File 8.15 from 0'04" to 0'06"), and then again as a co-singing gesture (0'06" to 0'09"). In both cases the student's head and hand motions converge with TS's hand gestures. In this interaction, there is no clear discourse theme. Instead we can see an approximate tracing of pitch contour in the vertical axis, as though the student is attempting to keep track of and remember the melodic pattern by producing sympathetic body motions.

8.5 Discussion and conclusions

The analyses above present examples of catchments, addressee gestures, and gestural convergence, together with examinations of the pedagogic interactions in which they occur.

Here I will discuss further how these features interrelate, and consider their causes and implications.

Catchments, in which gestural forms or actions are repeatedly used to refer to the same musical features, have been found throughout the lessons examined. Drawing on evidence from the analyses in this chapter and research from the wider fields of gesture and communication studies, I propose that catchments in this context promote comprehension by creating and updating common ground between teacher and student. This is possible due to the way in which gestures can act to ground musical qualities in more concrete physical actions based on cross-domain mappings arising from correlations in perceptual experience (see chapter 7). In catchments these somewhat malleable connections between qualities of music and gesture are rendered temporarily stable through reiteration of a particular gestural form with the same musical referent. In vocal lessons, this reiteration tends to occur within the unifying context of attempting to achieve a particular pedagogic goal: to correct an error in the student's rendition.

Studies of gesture in non-musical learning contexts have claimed that both catchments and gestures in general contribute to student learning. In the context of classroom mathematics learning, it has been suggested that catchments forge conceptual connections between different entities, thus creating common ground and improving students' understanding (Nathan and Alibali 2011, p. 257; see also Alibali et al. 2013, p. 433). The proposal that gestures aid student learning through grounding of abstract concepts has been tested using experimental methodologies in a number of studies (see Goldin-Meadow and Wagner 2005 for an overview). In one example, children who watched a lesson on symmetry during which the teacher produced gestures learned more than those who viewed the lesson without gesture (Valenzeno et al. 2003). Similar results have been observed in bilingual education (Church et al. 2004), and in teaching mathematical equivalence problems (Perry et al. 1995). Furthermore, Cook et al. (2013) found that the use of gesture in mathematics teaching improved both consolidation of student learning and transfer of that learning to different problem types. Considering the results of such studies it seems possible that gesture in Karnatak vocal lessons, in which gestures similarly ground information and thus contribute to shared understanding, could improve student comprehension and learning. However, in order to determine whether this is the case, research using an experimental design should be conducted.

The analyses in this chapter have provided examples of links between particular gestural forms and musical motifs persisting across different lessons given by one teacher that were separated by two years. Evidence presented by Rahaim (2012 p. 65) of gestures recurring across several performances suggests that these examples in Karnatak music contexts are not exceptional cases. It is clear, also, from the interviews conducted in the

course of my research, that some students come to connect certain phrases with particular hand gestures. For example, SV mentioned that when singing songs taught to her by her guru, she tends to involuntarily visualise his form and hand movements, and that this helps her 'touch' the *bhāva* of the composition being sung (interview with SV, Chennai, 18 August, 2014). Similarly, one of SV's student's noted that over the years she had come to understand her teacher's hand gestures to the extent that they could convey what was required without the need for other information (SV and three students, Chennai, December 28, 2013; full quote in section 5.3.7). Therefore, habitually produced connections between gesture and motif may contribute to students' ability to understand and remember how to sing particular phrases.

During trouble spots in the lessons analysed, addressee gestures and catchments frequently arose in tandem as part of the teacher's attempt to address a particular pedagogic problem. Teachers' addressee gestures often consisted of only the catchment action, which was typically the segment from the teacher's demonstration gesture that co-occurred with the student error being corrected. This points towards such addressee gestures being linked to the pedagogic intent of the teacher. Addressee gestures that repeat the form of the teacher's co-singing gesture not only provide the same information again, but also effectively link the student's performance to that of the teacher through repetition of the gesture at the same point of the phrase.

In addressee gestures produced by teachers, the extent of coordination between their addressee gesture and the corresponding musical motif sung by the student was observed to vary. Sometimes teachers' addressee gestures occurred simultaneously with the student's performance of the motif in question, in which cases there may be a more explicit attempt to guide the student (see for example TS's addressee gestures in Media File 8.13 from 0'09" to 0'10", and 0'13" to 0'14"). However, teachers' addressee gestures often occur slightly after the student has sung the relevant motif, in which case they may, at first glance, seem somewhat redundant (see, for example, Media File 8.1 at 0'13"). Such late addressee gestures could be viewed as 'involuntary compensatory movements' akin to those discussed by Knoblich et al. (2011), wherein people produce movements that attempt to compensate for an error they see in someone else's actions (pp. 88-89). Therefore, vocal teachers' late-occurring addressee gestures could be regarded as involuntary movements made in response to observing their students going in a (musical) direction that is incorrect, much like the way in which people watching a ball moving towards a goal tend to move left when the ball moves too far to the right, even though they have no control over the ball (De Maeght and Prinz, 2004). Nevertheless, even if a teacher's addressee gesture is an involuntary compensatory movement, the gesture may still contribute to building a shared understanding of the error's

location and the nature of the solution, thus assisting the student in his or her subsequent attempts.

While addressee gestures produced by teachers have the potential to guide students' renditions, addressee gestures performed by students play a somewhat different role. Students' addressee gestures in the lessons analysed frequently mirrored segments of their teacher's immediately preceding gestures. Such gestural convergence, which was also found in students' co-singing gestures, can be understood in two ways. The first is that mimicry of salient points of a teacher's gesture communicates acceptance and understanding of what the teacher is attempting to convey. Such indication of acceptance or 'projected evidence' has been proposed as a necessary element in both verbal and gestural interaction (Clark 1996; see also Holler 2010). Another possible benefit of students' gestural mimicry concerns embodiment of desired musical qualities. As argued in chapter 6 and 7, teachers' gestures tend to map pitch movement and also index qualities such as emphasis, dynamics, and musical motion. By spontaneously mirroring their teachers' physical motions, students may gain better understanding of the rendition required due to the insight created through such physical embodiment of musical motion. These two ways of understanding gestural mimicry are not mutually exclusive, as gestural convergence may contribute to successful interaction, and also assist in understanding qualities of musical motion.

The analyses of teacher-student interaction presented in this chapter demonstrate that although certain qualities of gestural motion tend to be linked to particular musical qualities (due to the correlations in perceptual experience discussed in chapter 7), the communication of such musical qualities through gesture can only be achieved through the creation and constant updating of shared understanding between teacher and student: the creation of common ground. The phenomena discussed here, including catchments, addressee gestures, and gestural convergence, all contribute towards shared understanding. Therefore, it can be seen that the need to create and maintain common ground exerts a strong force over the manifestation of gestures in this context.

9 Final Conclusions

9.1 Introduction

In this thesis I have explored the topic of gesture in two Karnatak music contexts: musical structure and pedagogic interaction. The following questions framed the research:

1. What insight can an examination of musical gestures (motifs and phrases) and musicians' sound-producing gestures provide into the structure of Karnatak music and the dynamic processes that engender the style?

2. What role do sound-accompanying gestures play in the pedagogic process?
    a. What musical qualities and features are indexed by teachers' hand gestures?
    b. How does such indexing contribute to the student's learning process?

In order to answer these questions, various forms of analysis were conducted on data gathered in the course of my fieldwork in South India. Analyses have focused on the music itself (chapters 2 and 3) as well as the lessons in which the music is transmitted (chapters 4 to 8), with the rationale that the two are interconnected, as the pedagogic process plays a significant role in the on-going formation of musical style. In addition, by examining both musical and physical gesture, I aimed to elucidate the connections that exist between the two in this context.

In this final chapter of the thesis, I will summarise the results and conclusions of each chapter before considering the ways in which my findings are relevant to wider questions arising in the fields of musicology and gesture studies. Finally I will present a closing statement regarding the relationship between physical and musical gesture in Karnatak music followed by suggestions for further research.

9.2 Part one: Gesture and Karnatak music structure

In the first part of this thesis I considered Karnatak music structure from a gestural perspective, looking at both musical and sound-producing gestures in this context. Two chapters were presented on this topic. **Chapter 2** examined melodic elements of the style as they are conceived of in theory and in practice, with the aim of elucidating Karnatak music structure in a way that is consistent with practice rather than theory. It was argued that melodic elements described here as *svara-gamaka* units are significant in musical practice

and fundamental to the style's structure. Furthermore, I proposed that *svara-gamaka* units and characteristic motifs formed from chains of such units often possess a particular gestural quality, required for the motif to contribute to the expression of the *rāga's bhāva*. To support this claim I provided initial evidence demonstrating that teachers require certain *svara-gamaka* units to be performed with particular patterns of emphasis, dynamics, timbre, attack and release. These qualities are referred to here as gestural due to their role in conveying information on the physical gestures through which sound is made, as proposed in ecological theories of music perception (see section 1.5.3).

In **Chapter 3**, I presented a joint musical and motoric analysis of a short extract of violin *rāga ālāpana*, seeking to provide an account of Karnatak melodic structure that focuses on the dynamic processes that form the style rather than the categorisation of discreet elements. My analysis demonstrated the way in which the performance of a *svara* is dependent on its immediate melodic context, thus providing evidence of coarticulation in the style. The analysis highlighted the stylistic tendency to form links between *svaras* and to subsume individual *svaras* under a wider, often oscillating, gestural movement.

9.2.1 Discussion of conclusions to part one

The findings in part one of this thesis regarding the coarticulatory forces in melodic structure and the significance of *svara-gamaka* units are important contributions to the field of Karnatak music analysis for the following reasons. Powers (1959) argued that the role and structure of *rāga* phrases in the South Indian *rāga* system had been neglected, and lamented the lack of analysis of the internal structure of *rāga* phrases as well as the external relationships between them (Powers 1959, p. 87). To this day, there has been little published analysis of the internal structure of *rāga* phrases in the style. While there has been interesting work on pitch analysis (see Komaragiri 2013; Subramanian, M. 2002, 2007; Krishnaswamy 2003, 2004), and music information retrieval (MIR) (Ishwar et al. 2013; Rao et al. 2014) in Karnatak *rāga* performance, neither of these arenas aims to present models of the dynamic processes that form the style. Therefore, I present my coarticulatory model in the hope of both informing and stimulating further research on Karnatak music structure.

My emphasis on *svara-gamaka* units resonates with the approach taken by Morris (2011) in which he lists the various motifs used to perform each *svara* in recordings of two compositions in different *rāgas*. My own analysis extends further, in that it provides evidence that such motifs are not only comprised of pitch and rhythm, but also often require specific gestural qualities conveyed through patterns of emphasis and dynamics. In addition, my research shows novelty in employing motoric as well as musical analysis to examine the dynamic processes through which the style is formed, defined here as coarticulatory in nature.

Such an approach could potentially be employed in the analysis of other styles, particularly those that are highly ornamented or melismatic. Furthermore, I suggest that analytical approaches that focus on 'gestural-sonic objects' (Godøy 2011), and consider sound-producing gestures are potentially illuminating for the analysis of any musical style.[43]

It is worth reflecting on the relationship between the gestural qualities of Karnatak music and the continued relative absence of notation in common use. It seems likely that the virtual impossibility of successfully notating the fleeting *anusvaras*, slides, oscillations, and patterns of emphasis played a role in preventing notation from becoming an important mode of music transmission in India. The movement towards standardisation in the Karnatak style in the early part of the 20th century saw agitation for compositions to be standardised through notation (Weidman 2006, pp. 216-225). However, this attempt to alter tradition has largely failed in South India with oral transmission prevailing and hand-written notation only used as a memory prompt for the versions of compositions handed down to students by their teachers.[44] If the attempt to shift to standardised notations that included indications of *gamakas* had been successful, it is possible that the subtle ornaments and characteristic gestural qualities of the style would have been greatly affected.

The evidence gathered from observing lessons and interviewing musicians suggests that performers understand the Karnatak style through a combination of gestural and atomistic conceptions, understanding the music as motifs and phrases that have a gestural quality, but conceptually anchoring such motifs to sequences of *sargam* syllables (theoretical *svara* atoms). It is, however, the *svara-gamaka* units and longer motifs formed from chains of such units rather than the theoretical *svaras* that are meaningful for the listener. A list of *svaras*, for example, cannot tell the listener which *rāga* the performance is in or convey the *rāga's bhāva*. *Svara-gamaka* units and longer motifs formed from sequences of such units, however, do successfully convey meaning, as it is from such motifs and phrases that the listener can identify the *rāga* and experience its *bhāva* (Viswanathan 1977, p. 31; Powers 1959). Furthermore, in order to convey the *bhāva* of a *rāga*, it is often not sufficient to characterise these motifs simply as pitch and rhythm. There are many motifs that must also be performed with particular gestural qualities, conveyed through specific patterns of emphasis, and change in loudness and timbre. Such particular gestural qualities are often linked to the requirement that certain *svarasthānas* in a *rāga* should be heard only very lightly or indirectly, as oscillations and *anusvaras* can help achieve such de-emphasis. However, even if the style's characteristic gestural qualities are regarded as arising from the requirement to de-emphasise

[43] A few studies have taken related approaches, including some discussed in section 1.6.2 (for example, Baily 1977; Montague 2012; and Bungert 2015).

[44] Published *sargam* notation does exist, but I rarely observed teachers using it. It was occasionally used for checking *sāhitya*, or for teaching *varṇams*.

certain *svarasthānas*, this does not detract from the role played by such gestural qualities in the aesthetics of the style.

9.3 Part two: Physical gesture in Karnatak vocal lessons

In the second part of my thesis, introduced in **Chapter 4**, I enquired into the role played by physical gestures in Karnatak vocal lessons. Here I asked two specific questions; what musical qualities are indexed by physical gesture, and how does such indexing contribute to the learning process? Four different analytical approaches were used to answer these questions, each corresponding to a separate chapter of the thesis.

Chapter 5 presented a thematic analysis of interviews conducted with teachers and students in South India in the course of my fieldwork. Although teachers emphasised that their gestures were spontaneous, occurring 'automatically' and without deliberate effort, the majority of teachers and students were of the opinion that the gestures helped students understand the phrases demonstrated. A number of musical features and qualities were mentioned as being indicated and communicated through teachers' gestures, including 'movement', *svaras*, *gamakas*, duration, pressure, and *bhāva*. In addition, it was suggested that teachers' gestures can help repair student error by highlighting the part that is incorrect and 'indicating the difference' with the hand gestures (SV and three students, Chennai, December 28, 2013). These suggestions from musicians were further explored in the chapters that followed.

Chapter 6 employed a combination of quantitative and qualitative analytical approaches to determine the extent of correspondence between pitch and hand position in lessons given by three different teachers, and to better understand what factors influence this relationship. Overall, a positive correlation between pitch and hand position was found, but it was only weak to moderate in strength, with some teachers showing higher tendency to map pitch to hand position than others. Individual phrases varied widely in the extent to which the two variables were correlated. Qualitative analysis showed that during lesson trouble spots (points where the teacher attempted to correct student error), mapping between pitch and hand position sometimes progressed in a way that suggested it could contribute to the learning process, for example, by indexing the solution to the student's error. It was suggested that when mapping between pitch and hand movement does occur it may help students grasp the often complex pitch movement within *svara-gamaka* units, including the subtle *anusvaras* that can be difficult to perceive. However, it was noted that the gestures observed often indexed musical qualities other than pitch.

Analyses of individual phrases showed that teachers' gestures often indexed the borders between smaller gestural-sonic chunks or motifs within the longer phrase. This

occurred both instead of, and in addition to pitch mapping. The chunks typically comprised meaningful melodic units of the type discussed in chapters 2 and 3, including individual *svara-gamaka* units as well as longer motifs comprising short strings of often coarticulated *svaras* subsumed under oscillatory melodic motion (see, for example, Media Files 9.1, 9.2, and 9.3). It was suggested that such segmentation of phrases into smaller chunks might assist students by drawing attention to the borders between meaningful units, and thus simplifying imitation of the wider phrase.

Chapter 7 enquired further into the question of what musical qualities are indexed by gesture, using a qualitative approach to analyse mapping between hand motion and musical qualities including emphasis, attack, release, loudness and timbre. Together these are some of the qualities that lie behind the perception of musical motion, as proposed in theories of ecological perception in music listening (see section 1.5). The chapter discussed metaphoric and iconic modes of communication apparent in co-singing gestures in this context and their basis in cross-domain mappings formed through accumulated physical experience. In addition, the types of hand actions observed were discussed with reference to existing literature on conducting gestures (Bräm and Boyes Braem 2001). It was found that many of the co-singing gestures could be classed as 'object manipulators' in which the hand enacted manipulation of an invisible object. Other gestures appeared to enact the motion of an object that had been manipulated; for example, rebound motions. Finally, some gestures appeared as self-generated motion not involving object manipulation; for example, swoops and flicks.

Fourteen pedagogic interactions were examined in detail. In each case, the metaphoric and iconic modes of communication in evidence were discussed, as were the experiential and bodily bases of the connections between gestural actions and musical features. In addition to the mappings observed between gesture and musical qualities such as emphasis, release, and change in timbre and loudness, it was suggested that there is iconicity between teachers' gestural motion and the musical motion they wish to convey through their vocal performance. I proposed, therefore, that gestures contribute to communicating both specific musical details and also the wider musical motion required.

Finally, in **Chapter 8** of this thesis I focussed on interaction between teacher and student, in order to further enquire into the role played by gesture in the learning process. Here I employed concepts and themes from the fields of gesture and communication studies, including common ground, gestural mimicry, catchments, and addressee gestures, applying them to analyses of segments of Karnatak vocal lessons. It was found that catchments (re-occurring gestural forms that refer to the same musical feature) commonly occur in lessons, and that teachers produce both catchments and addressee gestures (gestures produced by the listener) during trouble spots in a way that indexes the solution to the student's error. Through the analyses, I showed how features such as catchments, addressee gestures, and gestural

convergence create common ground between teacher and student and thus contribute to the pedagogic process.

9.3.1 Discussion of conclusions to part two

Here I will consider how the accumulated findings from my analyses contribute to answering the original research questions posed in this thesis.

a) What musical qualities and features are indexed by teachers' hand gestures?

My analyses demonstrated that musical features indexed by teachers' gestures include pitch, *svara* change, boundaries between motifs (segmentation), duration, emphasis, change in loudness and timbre, and qualities of attack and release. Several of these features are often indicated within one continuous hand gesture, either simultaneously or consecutively. Furthermore, my analyses provided details of the progression of such indexing across lesson trouble spots, and of how gestural indexing can be responsive to the pedagogic requirements of the moment. The findings from my analyses were in accordance with comments made by Karnatak musicians during interviews, in which it was noted that gesture could show the 'movement' of *saṅgatis* (phrases), motion between *svaras*, various qualities of *gamakas* including pitch movement and emphasis, *bhāva*, and where change was required in a student's rendition.

I suggest that teachers' hand gestures can also be interpreted as enacting the wider qualities of musical motion that they want to hear in their student's rendition. Musical qualities such as emphasis, and changes in loudness and timbre are viewed in ecological approaches to musical listening as suggestive of underlying gesture and motion (see sections 1.5.2 and 1.5.3; also Clarke 2001; Shove and Repp 1995; Windsor 2011). From this perspective, therefore, when teachers produce gestures that index such musical qualities, they are in effect enacting the musical motion they wish to hear expressed through the student's rendition. For example, I would suggest that in Media File 9.4, SV wants to hear something of her gesture's circular motion in her student's rendition, and in Media File 9.5, TS wants to hear the motion quality of her pushing gestures in her student's imitation of the phrase. In some cases, the musical motion indicated by the teachers' gestures are required for the motif to convey the *rāga's bhāva* (for example, Media File 9.6), while at other times they are more an individual interpretative choice (for example, Media File 9.4).

b) How does such indexing contribute to the learning process?

While the indexing of musical qualities observed does not in itself demonstrate that gestures contribute to the learning process, I have, in the course of this thesis provided evidence that

supports this being the case. Firstly, and importantly, I have presented comments made by the Karnatak musicians interviewed, the majority of whom felt that teachers' gestures contributed positively to the learning process, and were able to provide numerous details of the ways in which gestures assist students in understanding the complex melodic motion of the style. Secondly, detailed analyses of trouble spots in lessons provided evidence that gestures were often linked to the teacher's pedagogic intent and thus potentially contributed to the pedagogic process. For example, addressee gestures made by teachers during trouble spots tended to occur only at the point of the student's error, rather than throughout the entire phrase (see chapter 8). Furthermore, such addressee gestures often took the form of the gesture made at the same point in the teacher's previous demonstration of the phrase, thus forging a connection back to the teacher's correct performance of the problematic motif. In such cases, it is clear that the gesture has the potential to contribute to the pedagogic process by indexing the student's error and modelling its solution.

In addition to the analyses presented in this thesis, existing experiment-based studies provide evidence that supports two proposals relevant to the impact of gesture in the present context; firstly, that physical gestures affect how the observer/listener perceives music, and secondly, that gestures can help students learn. While this literature has been referred to in the course of my thesis, I will summarise it here in order to support my final argument regarding the contribution of gestural indexing to the learning process.

Regarding the first proposal, that sound-accompanying gestures affect the perception of music, studies have shown that gestures can influence the perception of pitch (Connell et al. 2013), and the duration of musical sounds (Schutz and Lipscomb 2007; Schutz and Kubovy 2009). Such evidence of cross-modal perceptual integration suggests that co-singing gestures in vocal lessons can influence the way that students hear music, a phenomenon that could be used towards pedagogic ends. Other research has shown that gestures affect musical sounds performed in response; for example, Erdemir et al. (2015) showed that conductors' gestures influenced vocal sounds produced in response, with connections found between the initial velocity of the gesture and the mean intensity of the sound produced, and also between the velocity variation in the gesture and the intensity variation in the sound. Finally, Munhall et al. (2004) demonstrated that head gestures have a positive impact on speech comprehension; an effect that they propose is caused by segmentation cues provided by the gestures. My analyses of Karnatak vocal lessons showed that in many cases, teachers' hand gestures segmented longer phrases into smaller meaningful chunks (see section 6.6.2). Therefore, the segmentation role played by co-singing gestures may have a similarly positive impact on comprehension and thus on learning in Karnatak vocal lessons.

The second type of experiment-based studies that are relevant to the role of gestures in vocal lessons are those that show gesturing helps students learn. Unfortunately, there have

been very few experiment-based studies attempting to assess the benefits of gesture in music learning contexts.[45] However, there have been several looking at the benefits of gesture in other learning scenarios, including classroom mathematics instruction and individual problem solving. The gestures considered in such studies have similarities to those observed in Karnatak vocal lessons in that they are typically either spontaneously produced, or of the type that might be spontaneously produced, and also act to ground concepts in physical action in a way that is similar to the grounding of musical qualities in physical action observed in Karnatak vocal lessons (see chapters 6 to 8). In such studies, the production of gestures by teachers has been found to benefit student learning of mathematical and geometry related concepts (Valenzeno et al. 2003; Church et al. 2004), and to promote consolidation and transfer of learning to other problem types (Cook et al. 2013). In addition, it has been shown that a combination of teacher and student gesturing helps learning persist (Cook et al. 2008; Cook et al. 2010). Considering the findings of such studies, it seems possible that gestures produced in Karnatak vocal lessons, both by teachers and students, would have a similarly positive effect on learning, retention of learning, and transfer of learning to other contexts. In order to determine whether this is the case, a study along similar lines to those used in the experiments mentioned here would have to be conducted in the present context.

In summary, therefore, I present a synopsis of the way in which I suggest vocal teachers' co-singing gestures function in Karnatak vocal lessons:

- Co-singing gestures arise spontaneously in the moment, the tendency to produce them having been formed through many years of interaction with teachers who also gestured.

- The gestures spontaneously index musical features and qualities through mappings based on connections forged through correlations in perceptual experience: our accumulated, embodied experience of interacting with objects and sound in everyday life. Furthermore, the tendency for gestures to take the form of object manipulations and object motion harks back to their origins in real-world interactions.

- Teachers' gestures often contribute positively to the pedagogic process by highlighting those musical features of which the teacher would like the student to be aware, and also by providing feedback to the student on what they have accepted.

[45] One example of such a study can be found in Liao (2008). However, this is not particularly relevant to the present context as gestures employed were not spontaneous but rather instructed and, in addition, were produced by the children rather than the teacher.

Students' gestures contribute to the pedagogic process by providing feedback to the teacher on what they have understood and accepted, and perhaps also by enabling them to embody the musical motion required in the phrase.

- Co-singing gestures play an important role in the learning process due to the prevalence in the style of complex and un-notated *gamakas* incorporating fleeting *anusvaras* that must often be performed with particular gestural qualities, all of which students typically struggle to perceive and reproduce. In these difficult circumstances, teachers' gestures provide an additional source of information regarding how a phrase is to be sung alongside the sound itself and other pedagogic techniques such as repetition using *sargam* and verbal interjection.

9.4 Relevance of findings to gesture production theories

A number of theories regarding why and how gestures arise have emerged from the wider field of gesture studies. However, the evidence supporting such theories is typically drawn from co-speech and co-thinking contexts, with none considering co-singing gestures. I would suggest that the spontaneous co-singing gestures discussed in this thesis have relevance for gesture production theories, and so in this section, some of these theories will be discussed in light of my findings.

Several prominent gesture production theories characterise gesture formation as indivisible from the speech production process. One example of such an approach is McNeill's 'growth point' theory, in which it is proposed that gesture production is intertwined with the generation of speech (McNeill 1992, 2005). According to this theory both gesture and speech originate from the same indivisible unit referred to as the 'growth point'. The dependency of gesture on the speech production process is further emphasised in this theory, as McNeill states that any abstract imagery associated with the growth point 'is categorised linguistically' and is 'never purely visuospatial' (McNeill 2005, p. 131). Other theories that tie gesture to speech production include the 'sketch model hypothesis' (de Ruiter 2000) and the 'lexical access model' (Butterworth and Hadar 1989). In light of the results of my analyses, as well as the existing research on co-singing gestures, the obvious problem with models that tie spontaneous gesturing to speech production is that co-singing gestures are produced in the absence of speech. In the Karnatak pedagogic context discussed here, lessons may continue for several minutes without any speech occurring, and performances with co-singing gestures may continue without speech for much longer periods of time. Furthermore, in these contexts, it cannot be maintained that gestures emerge with speech that lies unspoken, as the majority of co-singing gestures observed in Karnatak vocal lessons refer to musical

qualities that are not directly related to, and also difficult to describe through speech. Therefore, the gesturing observed in Karnatak vocal lessons does not support any gesture production theories in which gesture is tied solely to speech production. In response to the anticipated counter-suggestion that co-singing gestures are somehow an entirely different case, I would argue that my evidence here shows otherwise. Like co-speech gestures, co-singing gestures are spontaneous and acquired through acculturation, and, as we have seen, like co-speech gestures in non-musical learning contexts, co-singing gestures assist in the creation and maintenance of common ground.

Alternative theories of gesture production that are more compatible with the results of the analyses in this thesis include the 'Information Packaging Hypothesis' (Kita 2000; Alibali et al. 2000) and the 'gestures-as-simulated-action' (GSA) framework (Hostetter and Alibali 2008), each of which will be discussed here in light of my findings.

The Information Packaging Hypothesis proposed by Kita (2000) and developed in Alibali et al. (2000) expands on the idea suggested by McNeill (1992) that gestures help constitute thought (1992, p. 245). The hypothesis proposes that gestures play a role in thinking as well as in speaking by assisting in the exploration of alternative ways of encoding and organising spatial and perceptual information (Alibali et al. 2000, p. 595). Rather than viewing gesture as solely tied to speech production as is the case in the Lexical Retrieval Hypothesis (for example, see Butterworth and Hadar 1989), gesture is instead seen as playing a role in conceptualisation more generally, being also involved in cognitive activities such as reasoning and problem solving (Alibali et al. 2000, p. 595). Thus, this hypothesis is compatible with findings on co-singing gesture in the present thesis where gesture arises in the absence of speech and in relation to cognitive activities involved in the teaching, learning, and performance of music.

The 'gestures-as-simulated-action' (GSA) framework is also compatible with gesturing observed in Karnatak vocal lessons. Here, Hostetter and Alibali (2008) emphasise that actions lie at the basis of gesture production, arguing that 'gestures are a natural expression of the simulated actions that underlie speaking and thinking' (2008, p. 504). Unlike the speech-dependent production theories, the GSA framework allows that gestures arise independently of speech production during activities such as problem solving and thinking. As I have shown, gestures in Karnatak vocal lessons often take the form of object manipulations: actions such as stretching or pushing performed on imaginary objects. Therefore, to slightly alter the formulation made by Hostetter and Alibali (see p. 504, quoted above), such object manipulations could be viewed as expressions of the actions that underlie musicking: actions connected to musical qualities through embodied experience of the causal relationship between movement and sound. Similar to the approach taken in my thesis, Hostetter and Alibali place emphasis on the significance of accumulated embodied

experience, and also consider the role played by object affordance in gestural production. However, by relying on the notion that gestures arise from 'perceptual and motor simulations' and 'sensorimotor representations', they leave themselves open to aspects of critiques levelled at simulation theories (Gallagher 2007, 2011b; de Bruin and Gallagher 2012) and also more generally at representationalism (Varela et al. 1991; Johnson 2007) which, it has been argued, reinforces the mind-body divide and allots the body only a limited role in cognition (see Johnson 2007, pp. 113-134).[46] A related criticism has been levelled at the GSA framework by Pouw et al. (2014) who note that in the GSA account, gestures are presented as the bodily realisations 'of otherwise covert sensorimotor activations' (p. 5) and, as such, do not allocate gesture a role in cognition. Pouw et al. (2014) argue that the GSA model 'does not allow the conclusion that gestures-as-bodily-acts aid cognition, because gestures only execute sensorimotor information, they do not produce it' (p. 5). This aspect of the GSA framework would be incompatible with the comments made in interviews by Karnatak musicians, who maintained that gestures help students 'understand' the music.

In conclusion to this discussion, I suggest that the results of my analyses on co-singing gestures are incompatible with gesture production theories in which gesture is solely linked to speech production. Instead, the evidence gathered here supports theories in which gesture is acknowledged to co-occur more generally with wider cognitive processes, including thinking and, more specifically, problem solving. In addition, my findings support gesture production theories that view gesture as intrinsically linked to real-world actions and connections formed through our embodied experience of interacting with the environment.

9.5 The role of gesture in thinking

In this thesis, I have focused on the communicative role of physical gesture, looking at how gestures index and convey musical qualities to the student and also contribute to the formation of common ground between teacher and student. However, Indian vocalists also gesture in the absence of an audience, while practicing alone for example (Rahaim 2012, p. 7). Similarly, looking beyond musical contexts, people have been observed to gesture while speaking to themselves or thinking (Goldin-Meadow 2003; Kita 2000). It appears, therefore, that physical gesture does not arise purely during communication between two or more people. There is, in fact, a growing body of work examining co-thought gestures, defined as gestures produced in 'silent, non-communicative, problem solving situations' (Chu and Kita 2011, p. 102; see also Chu and Kita 2016; Logan et al. 2014). Kita argues that co-thought

[46] Objections to representational approaches to cognition are discussed in more detail in sections 1.4.2 and 1.4.5 of this thesis.

gesturing cannot be viewed as arising solely due to habit, because in such scenarios, the types of gestures that are meant to be seen by another person are not produced, while other gestures still arise (Kita 2000, p. 162). In support of this point Kita refers to a study by Bavelas et al. (1992), which showed that when there is no visual contact with an interlocutor, those gestures aimed towards involving the other person are produced less frequently, while the frequency of gestures purely related to the topic of conversation is unchanged. Therefore, co-thought gestures cannot be viewed as a meaningless habit, but rather should be seen as playing a role in the particular circumstance. Following from this, I would suggest that co-singing gestures produced by a singer when alone are not purely habitual, but also play a role in the process in which the vocalist is engaged.

Considering the mounting evidence that gestures help people think and solve problems as well as communicate (Chu and Kita 2011, 2012, 2016; Kita 2000; Goldin-Meadow 2003; Logan et al. 2014) it seems likely that co-singing gestures similarly help performers think and problem solve about music. However, some researchers have gone further to suggest that gestures are themselves a form of thought (see Clark 2013). An early suggestion along these lines was contributed by Mead (1934) who observed, 'The internalisation in our experience of the external conversations of gestures which we carry on with other individuals in the social process is the essence of thinking' (p. 47). Here Mead is referring to speech gestures in particular. However, it should be remembered that Mead views speech and physical gestures as connected through their common function, which is the presentation of attitudes that call forth a response in another (1934, p. 14). By extension, therefore, physical gestures might also be considered part of thinking.

Merleau-Ponty, similarly to Mead, suggests that language is itself thought:

> […] the word, far from being the mere sign of objects and meanings, inhabits things and is the vehicle of meanings. Thus speech, in the speaker, does not translate ready-made thought, but accomplishes it. (Merleau-Ponty 1945/1962, p. 178)

Following from Merleau-Ponty's ideas on language and thought, Gallagher (2005) comes close to proposing gesture also as a form of thought, but stops short, stating instead, 'Merleau-Ponty tells us that language accomplishes thought. It seems quite possible, then, that gesture, as language, assists in that accomplishment' (2005, p. 121). Clark (2013) notes that Gallagher's formulation here sidesteps the question of whether gesture might be seen as part of the 'actual machinery of thought and reason' (Clark 2013, p. 260), and suggests that Gallagher at least implies such a position in the following extract which equates mind with modes of expression:

> […] certain aspects of what we call the mind just are in fact nothing other than what we tend to call expression, that is, occurrent linguistic practices ('internal speech'), gesture, and expressive movement. (Gallagher 2005, p. 121)

This, however, is as far as Gallagher is willing to press the case for gesture as thought, and his position remains that gesture assists and shapes cognition (2005, pp. 122-123).

Clark (2013) instead proposes that gesture is part of the process that constitutes thinking, arguing that the very thing that materialises a thought (in this case gesture) can also be that which helps move the cognitive process along (p. 263). Thus for Clark, gesture is 'both a means of bringing a thought to completion and an operator that helps transform one state of understanding into another' (p. 263). Clark's concept of gesture as part of thought has been elaborated on by Pouw et al. (2014), who propose that 'gestures may at times serve as external tools of the cognitive system' (2014, p. 2), providing 'the cognitive system with a stable external, physical, and visual presence that can provide a means to think with' (p. 11).

Both proposals discussed here, that gesture assists thought and that it is a mechanism of thought, have implications regarding the role played by gestures in Karnatak vocal performance and teaching. I will first consider the idea that gesture assists thought. The contribution of gestures to learning and the retention of learning has already been discussed in this chapter (Cook et al. 2010; Cook et al. 2013). In addition, gestures have been shown to assist the retrieval of words from lexical memory (Rauscher et al. 1996), and also lighten cognitive load when a person is simultaneously attempting to explain and memorise (Goldin-Meadow et al. 2001). Following from these findings, it is possible that in Karnatak performance contexts co-singing gestures may similarly assist vocalists in retrieving characteristic phrases from memory, and also lighten cognitive load. Karnatak music performance depends on execution of multiple cognitive tasks including recalling characteristic phrases or compositions (notation is rarely used in performance), while simultaneously elaborating the phrases in keeping with the style, and also keeping track of the *tāla* (passage of the metrical system) in those musical forms that have metre.

Turning to the idea that gesture is part of the process that constitutes thought, the suggestion made in Pouw et al. (2014), that gestures provide an external physical presence with which to think, could equally be applied to co-singing gestures. In this thesis, I have shown that co-singing gestures index musical qualities and features, thus grounding them in physical action, and that gestures occasionally form temporarily stable connections with musical features, referred to here as catchments (see chapter 8). Therefore, following Pouw et al. (2014), gestures in this context could be considered 'external tools of the cognitive system' (p. 1), providing singers with a physical and visual presence with which to think about music.

Thus, I would suggest that gesture in musical contexts would be a fruitful arena for further research on gesture as part of thought.

9.6 Connections between musical and physical gesture in Karnatak music

In section 1.6.1 of this thesis, I presented two definitions of gesture that can be applied equally to musical gestures (motifs and phrases) and physical gestures, thus delineating features common to both. The first of these definitions connects musical and physical gesture through the body movement that underlies both (for example, see Windsor 2011), while the second definition is based on Mead's (1934) formulation of gesture as an attitude that calls forth a response in another, which Coker (1972) realised could be applied equally to musical gestures. Here I will discuss these two definitions of gesture in the specific context of Karnatak music, and in light of the results of my analyses.

The connections between musical and physical gesture through the body motion that underlies both can be viewed diagrammatically in Figure 9.1. This network of relations is founded on the fundamental link between movement and sound (movement creates sound), and the ecological principle that listeners perceive something of the movement that created the music, or that is suggested through its structure (see sections 1.5.2 and 1.5.3).

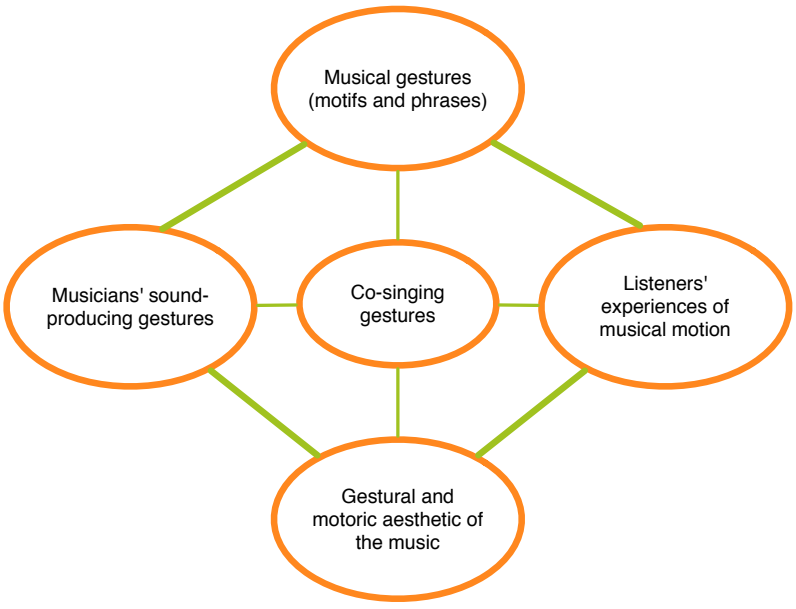

Figure 9.1: Visualisation of the connections between musical and physical gestures in Karnatak music.

In addition to visualising this relationship between sound-producing gestures, musical gestures and listeners' experiences of motion, Figure 9.1 includes an element referring to the

gestural or motoric aesthetic of the music. This element is an acknowledgment that music is formed (composed, improvised, and performed) so as to convey pleasurable or otherwise interesting experiences of motion: the motion aesthetic of the music. In addition, the co-singing gestures discussed in this thesis can be seen at the centre of Figure 9.1, linked to all manifestations of gesture identified.

In this thesis, I have presented examples of the myriad ways in which Karnatak musical and gestural practices are connected through the body motion that underlies both. I have argued that Karnatak music as it exists in practice is best conceptualised as formed from *svara-gamaka* units and longer motifs constituting sequences of such units. These units are, in effect, gestural-sonic chunks as defined by Godøy (2011): segments of music in which individual notes are subsumed under the wider gestural motion that produces them. In chapters 2 and 7, I presented evidence for my argument that some Karnatak motifs must be performed with particular patterns of emphasis and de-emphasis in order that they might convey the *bhāva* of the *rāga*. Furthermore, I have shown that teachers put considerable effort into conveying the gestural qualities of musical motifs to their students, and that their co-singing gestures can contribute to indicating points of emphasis and de-emphasis, while also mapping qualities of musical motion (see chapter 7). In addition, I found that during interviews musicians drew connections between their co-singing gestures and various musical qualities, with some also noting connections between co-singing gestures and the physical effort required to produce the music (see section 5.3.8). Thus, I have provided a wealth of detail on the ways in which music and gesture are connected in this context, while also drawing from existing literature to propose the experiential bases that afford such connections (see chapter 7).

The second definition of gesture discussed in section 1.6.1 of this thesis is Mead's (1934) formulation of gesture as an attitude that calls forth a response in another person, making adjustment possible between individuals involved in a social act (p. 46). Following Coker (1972), I proposed that the same could be said of musical gestures, and that musical motifs are well defined as attitudes that draw forth a response from the listener, affording the listener's adjustment in response to the music. In Karnatak music, *svara-gamaka* units, as well as longer motifs and phrases comprised of such units, carry meaning in the style due to their ability to express the *bhāva* of the *rāga* (see sections 2.5-2.8). These are musical gestures, presented by the performer as attitudes in expectation of calling forth a response from the audience (including fellow musicians on stage) allowing them to adjust with respect to the music and its *bhāva*, as well as to the performer. In lessons, the physical gestures of teacher and student present attitudes that call forth a response and allow each person to adjust with respect to the other. It is this interactive quality of gesture that both creates and maintains common ground in Karnatak vocal lessons as described in chapter 8.

Thus I have described the twin aspects of gesture, the bodily and the interactive, both of which are immanent in physical and musical gesture. Furthermore, these two aspects of gesture are themselves connected through the involvement of bodily motion in the formation of each: the presented 'attitude' in Mead's (1934) formulation also requires bodily motion for its realisation. The musical attitudes conveyed in the Karnatak style have both sonic and gestural qualities, and I propose that the communication of aestheticised motion through sound is an important element of Karnatak music. However, I do not suggest that the style is unique in this respect, as all musical genres have their own characteristic motion aesthetics. The results of the analyses conducted in this thesis suggest that the motion aesthetic of the Karnatak style can be heard in the music and also seen in the gestures used to teach the style,[47] thus demonstrating the inextricable links between music and physical movement.

9.7 Suggestions for further research

The findings and discussions presented in this thesis suggest several areas in which further research could be conducted. While the beneficial contribution of physical gestures to learning and the consolidation of learning has been demonstrated through experiment-based studies in mathematics and problem solving contexts (for example, Valenzeno et al. 2003; Cook et al. 2013), no experiments using similar methods have been conducted in musical contexts. Such a study would more clearly determine whether gestures produced by music teachers help students accurately imitate musical phrases and also retain this learning. In addition, there are potential areas for further research based on observation of ecological musical practices, such as an examination of the differences between co-singing gestures produced in pedagogic and performance contexts, a subject that has only been touched on in this thesis. Furthermore, the findings presented in this thesis relating to the persistence of gestural catchments over time suggest that there is scope for a dedicated study looking at this phenomenon.

I believe that there is further scope for research into Karnatak music structure in light of my findings presented in chapters 2 and 3. In particular, I suggest that significant potential exists for analyses of Karnatak *rāga* performance with respect to the gestural-sonic chunks that constitute the style, including *svara-gamaka* units and the longer motifs comprised of series of such units, as these are the structural units that carry musical meaning due to their ability to express *rāga bhāva* (see sections 2.5-2.8). Finally, I suggest there is scope for further research on the expression of motion through music, drawing on theories of ecological

[47] See in particular the comments made by Karnatak teachers and students on the ability of gesture to convey *bhāva*, emphasis, and movement (section 5.3).

musical perception (for example, Clarke 2001; Windsor 2011). Such work could aim to define the qualities of musical motion typically expressed in particular musical styles, an approach in keeping with Godøy and Jensenius's (2009) suggestion that 'sensations of body movement are one of the most salient features of musical style and genre' (p. 49). Such analyses of the motion aesthetics of particular musical styles could perhaps employ theories and techniques presented in work by Godøy (2010), Godøy et al. (2010), and Haga (2008) in conjunction with music analysis.

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